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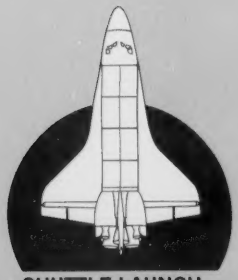

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Scientific and Technical Aerospace Reports (STAR) is a major component of a comprehensive National Aeronautics and Space Administration information system covering aeronautics, space, and supporting disciplines. *STAR* is issued on the 8th and 23rd of each month and announces current publications of the following types:

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Subject scope of *STAR*, *IAA*, and *On-Going Research Projects* includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

Each major division is further divided into as many as nine specific categories, which are identified by category numbers.

Abstracts in *STAR* are grouped by specific category, the categories appearing in sequential order. Category breaks in the abstract section are identified by the category number and title, and a scope note. Cross-references to other categories are provided as appropriate. For example:

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

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SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) 276
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 277
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 280
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE N.A.
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 283
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) 285

89 ASTRONOMY 285
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 285
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 286
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

92 SOLAR PHYSICS 286
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 286
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

99 GENERAL 287

Note: N.A. means that no abstracts were assigned to this category for this issue.

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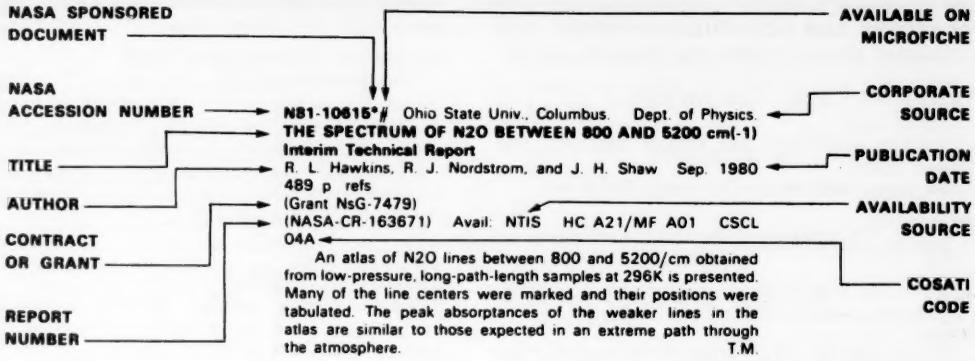
TYPICAL CITATION AND ABSTRACT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N81-10615*# Ohio State Univ., Columbus. Dept. of Physics.
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THE SPECTRUM OF N2O BETWEEN 800 AND 5200 cm(-1)
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An atlas of N2O lines between 800 and 5200/cm obtained from low-pressure, long-path-length samples at 296K is presented. Many of the line centers were marked and their positions were tabulated. The peak absorptances of the weaker lines in the atlas are similar to those expected in an extreme path through the atmosphere. T.M.
REPORT NUMBER

ON-GOING RESEARCH PROJECTS

This is a listing of research projects - not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, DEVELOPMENT OF A SMALL-SCALE V/STOL PROPULSION SIMULATOR FOR MODELLING GROUND EFFECT FIELDS

P.A. Lord, California State University & Colleges, California State Polytechnic University, School of Engineering, Dept. of Aerospace Engineering, *3801 W. Temple Ave., Pomona, California* 91768 (NAG 2-49)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

1.0002, HELICOPTER AUTOMATIC PILOT PERFORMANCE IN ADVERSE WIND CONDITIONS

G.R. Clary, Claremont Colleges, Harvey Mudd College, Undergraduate School, *Claremont, California* 91711 (NCC 2-90)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

1.0003, NEW STRATEGIC AIRLIFT CONCEPTS

F. Newton, McDonnell Douglas Corp., *3855 Lakewood Blvd., Long Beach, California* 90808 (DF142580; F33615-78-C-3017)

An analysis of a future conflict between NATO and Warsaw Pact forces indicates intense fighting, with corresponding rapid consumption of military equipment. This equipment must be replaced, and supplemented, at a rate possible only with rapid airlift. This scenario is the consequence of the increasing size of the Warsaw Pact forces, and it places demand on MAC and the strategic airlift resources, which may require the design of a new AF cargo aircraft. The AFFDL has the responsibility to conduct design integration studies and technology development for future systems. A conceptual design program will be conducted to determine the feasibility of new strategic airlift aircraft.

A contractor shall conduct a design integration study within the context of a scenario involving airlift to NATO forces. The design requirements will incorporate the findings of the Massive Rapid Resupply study contracts presently being performed. The analysis will define the vehicle in terms of range, payload, speed and related parameters, as well as force size, maintenance requirements, interface with Army equipment, and similar support requirements. The payload requirements will reflect projections of future Army weapons specifically designed for the intense NATO conflict. The finding from this study will be suitable for specifying future technology requirements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0004, LARGE AREA COMPOSITE STRUCTURE REPAIR

J.D. Labor, Northrop Corp., *3901 W. Broadway, Hawthorne, California* 90250 (DF135810; F33615-76-C-3017)

Advanced composite structural components are now in limited use on military aircraft. Future weapon systems will use composite structural materials in wider applications. Required criteria, techniques and facilities for depot level repair do not exist. This effort will develop and provide needed criteria and techniques to perform cost-effective repairs which will minimize life-cycle costs.

Cost-effective depot level repair criteria and techniques applicable to large area advanced composite structures on military aircraft will be developed. A review of advanced composite structure technology and the operations, facilities and capabilities of AFLC maintenance and repair depots will be followed by an in-depth study and analysis of the unique problems encountered in the repair of large area composite structures. A number of specific repairs will be made on which structural tests will be conducted.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0005, AIR-TO-GROUND COCKPIT DESIGN

F. Drsata, Rockwell International Corp., *International Airport, Los Angeles, California* (DF140000; F33615-77-C-3070)

This work unit supports AFSC development goal TW6. Advances in sensor technology and on-board computation capability could exceed the systems management capability of aircraft flight crews using existing control/display techniques. The objective of this work unit is to evolve guidelines for fighter aircraft crew stations designed to perform the air-to-ground weapon delivery task. Identification will be made of potential areas for subsystem integration that would relieve excessive crew workload and, at the same time, enhance mission effectiveness of the total weapon system. One specific objective is to provide cost trade-off data to help resolve the issue of crew size versus mission capability.

Mission, threat, and functional systems analyses will be performed for candidate air-to-ground aircraft. Required mission performance characteristics will be assembled into a detailed mission scenario and specific system task requirements will be identified. Detailed crew task time-lines will be developed. A crew station mock-up will be constructed based on a design incorporating advances in weapon technologies, control and displays and optimized anthropometically. Pilots from operational/user commands will evaluate the mock-up in a structured mission environment. Evaluation results will provide initial data on the appropriateness of the instrument configuration, crew procedures/checklists, and the trade-offs between crew size and avionics sophistication. Follow-on mock-up iterations and/or part task simulations will be used to assess developed guidelines.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0006, JOINT INSTITUTE FOR AERONAUTICS AND ACOUSTICS STUDIES OF ROTOR AEROACOUSTICS

K. Karamcheti, Stanford University, School of Engineering, Dept. of Aeronautics & Astronautics, *Stanford, California* 94305 (NCC 2-89)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

1.0007, RESEARCH PROGRAM IN AERONAUTICS
H.L. Liebowitz, George Washington University, School of Engineering & Applied Sciences, *725 23rd St. N.W., Washington, District of Columbia* 20037 (NCC 1-44)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

1.0008, A SEPARATED FLOW STUDY
M.H. Clarkson, State University System of Florida, University of Florida, School of Engineering, Dept. of Engineering Science & Mechanics, *220 Black Hall, Gainesville, Florida* 32611 (NGT 10-005-800)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

1.0009, ADVANCED TRANSONIC W/B DESIGN METHODOLOGY
M.E. Lores, Lockheed Georgia Co., *86 S. Cobb Dr., Marietta, Georgia* 30060 (DF141350; F33615-78-C-3014)

The Air Force function for this effort is the design development of both transport and fighter aircraft. Transports, which cruise at transonic speeds, and fighters, which maneuver at transonic conditions, have been designed in the past by use of 2-D transonic and 3-D subcritical methods, although most problems are 3-D and transonic in nature. The objective of this effort is to develop more efficient transport and fighter configurations than possible in the past and at a lesser cost. This work will contribute to more fuel efficient transports and more maneuverable fighters at transonic speeds as well as reducing the cost of designing these aircraft.

Recently developed 3-D transonic methods will be incorporated into a design procedure and applied to the development of a transport and a fighter configuration. The configurations will be tested in a wind tunnel and the results of the tests will be used to verify or improve the computer code.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0010, MULTI-LEVEL SEMANTIC ANALYSIS AND PROBLEM SOLVING IN THE FLIGHT DOMAIN
R.T. Chien, University of Illinois, Urbana Champaign Campus, Graduate School, *Urbana, Illinois* 61801 (NAG 1-90)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

1.0011, GRADUATE STUDENT TRAINING PROGRAM IN COMPUTATIONAL FLUID DYNAMICS
D.A. Anderson, Iowa State University of Science & Technology, School of Engineering, Dept. of Aerospace Engineering, *496 Town Engineering Bldg., Ames, Iowa* 50011 (NGT 16-002-801)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Aeronautics & Space Technology

1.0012, INVESTIGATION OF VARIABLE CAMBER DEVICES FOR HELICOPTER ROTOR SYSTEMS
R.P. Zerwekh, University of Kansas, Lawrence Campus, School of Engineering, Dept. of Mechanical Engineering, *Learned Hall, Lawrence, Kansas* 66044 (NCC 2-92)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

1.0013, MILITARIZED HELICOPTER TRANSPORTED CONTAINER HANDLING DEVICE
S.P. Jarosinski, Martin Marietta Corp., *1450 S. Rolling Rd., Baltimore, Maryland* 21227 (DA0E3844; DAAK51 78 C 0026)

The objective of this contract is for ATL to procure an operational prototype helicopter transported container lift adapter to be used for flight evaluation and operational suitability testing.

Martin Marietta Corp. shall furnish all resources necessary to procure and fabricate the required materials and components for the assembly and limited acceptance testing of two container lift adapters. Fabrication and assembly shall be in accordance with government-furnished drawings and instructions.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0014, AIRCRAFT ENGINE CONDITION MONITORING BY VIBRATION AND SOUND FREQUENCY SPECTRUM ANALYSIS
H.D. Behm, Western Michigan University, School of Applied Sciences, Dept. of Transportation Technology, *Kalamazoo, Michigan* 49001 (NAG 3-92)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

1.0015, EFFECT OF SERVICE ENVIRONMENT ON F-15 BORON EPOXY STABILATORS
T.V. Hinkle, McDonnell Douglas Astronautics Co., *E. 411 St., St. Louis, Missouri* 63166 (DF140780; F33615-77-C-3124)

There is laboratory evidence that the mechanical properties of epoxy matrix composite materials are degraded by moisture absorption. Available data on the effects of moisture pick-up during in-service operation on aircraft components are limited. There is a need for additional information to establish a technology base from which structural life predictions can be made for composite materials. The program objective is to accomplish this by evaluating the moisture levels and strength of the horizontal stabilators on the F-15 aircraft after extended periods of service.

Two F-15 in-service stabilators that have a well-documented high humidity environmental history will be used as test specimens for this program. The first specimen will be used to establish a base line by conducting a moisture content analysis of the stabilator in the as-received condition and compare the results with analytical methods. A series of tests will then be performed on humid-aged coupons cut from the stabilator to determine structural degradation at various moisture levels. The second F-15 stabilator will be installed on another aircraft for additional service environmental exposure and then evaluated as a part of a future program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0016, DEVELOPMENT OF IMPROVED FATIGUE LIFE TRACKING SYSTEMS FOR NAVY AIRCRAFT
R.E. Pinckert, McDonnell Douglas Corp., *P.O. Box 516, St. Louis, Missouri* 63166 (DN081258; N62269-79-C-0225)

To develop improved fatigue life tracking systems for Navy aircraft in order to achieve significant improvements in the accuracy of fatigue-life-expended estimates of fleet aircraft. This contract will support work unit ZA-601, Aircraft Technology, Agency Accession No. DN 681080.

Program will be done in two phases. Phase I will be a conceptual design, analytical assessment and cost optimization of candiate tracking systems. Phase II will be a flight test and laboratory evaluation of the function and accuracy of the improved systems.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate

1.0017, ENVIRONMENTAL LIGHTING LAB - EVALUATION OF FIBER OPTICS TO INCREASE SIMULATION CAPABILITY
J. Connelly, Grumman Aerospace Corp., *S. Oyster Bay Rd., Bethpage, New York* 11714 (DF144470; F33615-79-C-3629)

Improvements in aircraft performance, addition of greater numbers of controls and displays in the crew station, and pressure to reduce crew sizes are not being offset by appropriate improvements in control of critical crew station display legibility factors. USAF pilot opinion surveys and other data sources show that there are many unsolved crew station lighting and display legibility problems. Development of an environmental

lighting laboratory with 'man-in-the-loop' simulation capability is necessary to address these problems. The purpose of this effort is to investigate methods of increasing the simulation capabilities of an environmental lighting laboratory 'feasibility design' developed by Grumman Aerospace Corp. The environmental lighting laboratory would be used to accomplish the following: test/evaluate new electrooptical displays/lighting systems, develop/refine display legibility design criteria, evaluate legibility of displays/control panels in mission-oriented realistic lighting environment, and evaluate the impact of environmental lighting variation on pilot's mission performance.

This effort is the second phase of a multi-phase program to design and fabricate an environmental lighting laboratory. During the first phase, Grumman Aerospace Corp. accomplished (USAF Contract F33615-77-C-3067) a conceptual design/feasibility study to determine which environmental lighting simulation requirements could be realized utilizing current electrooptical technology. The second phase includes the procurement, fabrication, and testing of electrooptical devices and fiber optic materials which have significant potential for overcoming compromises made (due to limited funds) in the conceptual design effort. The results of this effort will be used to accomplish a simulation capability/cost trade-off investigation that identifies the most cost-effective environmental lighting laboratory design.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0018, STABILIZED SKIN STUDIES

M. Plummer, Grumman Aerospace Corp., *S. Oyster Bay Rd., Bethpage, New York* 11714 (DF142070; F33615-78-C-3215)

Performance requirements of advanced military aircraft indicate the desirability of using titanium as a major structural material to achieve the necessary strength-to-weight fraction, thermal capability, or both. The high cost of both the material and conventional primary production processes makes acquisition costs for titanium structural hardware non-competitive with more conventional materials. The objective of this effort is to define design options utilizing advanced titanium construction methods which allow more efficient use of material and production innovations. A goal of 25 percent or more acquisition cost reduction with no sacrifice of structural weight, integrity, or life is required.

A number of stabilized skin panels utilizing superplastic forming and diffusion bonding will be designed to satisfy realistic type design criteria. They will be fabricated and tested. The results will be analyzed, tabulated, and compared with the best existing design technologies presently in production use.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0019, THE NONLINEAR POTENTIAL EQUATION AND ITS CONVERSION TO A FFOWCS WILLIAMS-HAWKINGS INTEGRAL EQUATION

M.P. Isom, Polytechnic Inst. of New York, Brooklyn Campus, Graduate School, Dept. of Mechanical & Aerospace Engineering, *333 Jay St., Brooklyn, New York* 11201 (NCC 2-87)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

1.0020, BOUNDARY LAYER STUDIES OF MODEL AND FULL SCALE VTOL INLETS IN THE DIFFUSION LIMITED FLOW REGIONS

M.A. Boles, University of North Carolina, North Carolina State University, Graduate School, *Raleigh, North Carolina* 27607 (NAG 3-89)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

1.0021, AERODYNAMICALLY FORCED VIBRATION OF RADIAL FLOW COMPONENTS

J.E. Caruthers, University of Tennessee, Knoxville Campus, School of Engineering, Dept. of Engineering Science & Mechanics, *W. Cumberland Ave. S.W., Knoxville, Tennessee* 37916 (NAG 3-86)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

1.0022, SCALING ANALYSIS OF THE ICE ACCRETION PROCESS FOR THE PURPOSE OF ESTABLISHING SCALING CRITERIA FOR EXPERIMENTAL TESTING

E.G. Keshock, University of Tennessee, Knoxville Campus, School of Engineering, Dept. of Mechanical & Aerospace Engineering, *W. Cumberland Ave. S.W., Knoxville, Tennessee* 37916 (NAG 3-90)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

1.0023, ROTOR BLADE DYNAMIC RESPONSE AND BALLISTIC DAMAGE SURVIVABILITY

H. Zinberg, Bell Helicopter Textron, *Hwy. 183, P.O. Box 482, Fort Worth, Texas* 76101 (DA0D4018; DAAJ02-75-C-0049)

To develop analytical techniques and modeling methods that will evaluate rotor blade survivability when subjected to ballistic damage in flight. The method shall be capable of evaluating composite and metal-constructed main rotor blades for ballistic impacts up to and including 23mm HEI. The boundary conditions for structural stability and the flight regime necessary for 30 minutes safe flight after impact shall be established.

New computer programs will be generated or existing programs modified to account for reduced blade stiffness resulting from ballistic damage. Input data for programs will be blade section properties, location, impact energy and amount of material removed as a result of damage. Program will calculate blade residual strength, blade dynamic properties, and coupled rotor airframe dynamic properties. Static and dynamic tests will be performed on damaged blades and/or blade sections to verify analysis.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0024, BOUNDARY LAYER RECEPTIVITY

C.E. Grosch, Old Dominion University, School of Sciences & Health Professions, Dept. of Oceanography/Mathematical Sciences, *P.O. Box 6173, Norfolk, Virginia* 23508 (NAG 1-96)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

1.0025, WIND TUNNEL EVALUATION OF AN AEROELASTICALLY CONFORMABLE ROTOR

R.P. White, Systems Research Lab. Inc., R A S A Division, *1055 J. Clyde Morris Blvd., Newport News, Virginia* 23602 (DA0E3777; DAAJ02-77-C-0046)

Investigate the ability to improve rotor operational qualities (i.e., performance, efficiency, loads, stability and handling qualities) by deliberately designing aeroelastic properties to exploit the inherent tendency for blades to deform elastically. Determine if significant, practical improvement can be made in rotor operational qualities, reliability and maintainability, and cost. This effort will be directed toward generation of advanced data pertinent to advanced Army aircraft, including UTTTA, AAH, and ASH.

Conduct thorough review of effects of aeroelastic properties on rotor operational qualities. Select specific significant parameters and objectives which can be evaluated with existing technological capability. Perform rigorous phenomenological studies of the results of parameter variations using advanced analytical tools. Design and fabricate wind tunnel models, and perform comprehensive tests to substantiate analytical findings. Carefully review results to determine specific parametric trends for improving rotor design. Where practical, interpret trends in

terms of full-scale design characteristics which may be applied in aircraft development.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0026, DYNAMIC RESPONSE OF COMPOSITE STRUCTURES TO NON-NUCLEAR THREATS

J.G. Avery, Boeing Co., *7555 E. Marginal Way S., Seattle, Washington* 98124 (DF137670; F33615-78-C-3403)

With increased usage of advanced composites as structural materials in aircraft components, the effect of threat-induced damage in a combat environment becomes increasingly important. Aircraft structural designs using composite materials tend to present some unique problems which need to be further explored. The objective of this program is to investigate the effects of non-nuclear threat mechanisms on aircraft structures fabricated from composite materials. As the result of this effort, the effects of threat damage mechanisms on composite structures will be understood and will provide a data base for the development of survivable composite structure design criteria and guides.

To be investigated is the damage that results from the interaction of non-nuclear threat mechanisms with composite structures and the effects that such damage has on the strength of the composite structures. Factors associated with the investigation will be threat types and the damage mechanism associated with each type of threat, various types of composite materials and structural concepts, the application of the various composite structural concepts, the damage produced by the various threat mechanisms and the effects on the strength of the structural composites produced by the damage. Data voids will be identified and test plans developed to fill these voids.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0027, NON-AXISYMMETRIC NOZZLE/AFTBODY FLOW FIELD ANALYSIS

K.M. Peery, Boeing Co., *7555 E. Marginal Way S., Seattle, Washington* 98124 (DF143720; F33615-79-C-3018)

The Air Force function for this effort is to improve present numerical methods used for pressure drag calculation of non-axisymmetric nozzle boattail configurations. The problem is that experimental testing of aircraft configurations in wind tunnels is becoming increasingly expensive. The objective of this effort is to devise a method, using the Navier Stokes equations, capable of predicting flow conditions in the near region of a non-axisymmetric nozzle boattail configuration. This type of analysis will demonstrate that a solution for the above-mentioned case can be computed which has the accuracy of wind tunnel data, but will result in a significant cost savings to the Air Force.

The approach will model the internal and external flow fields, which will be input upstream of the exit, near the nozzle. The analysis encompasses the ramp and the lower surface of the cowl with the upper surface cowl solution being 'patched' into the lower region solution. By using this method, good definition of the flow field and plume boundary should be achieved. Turbulent flow will be assumed over the entire region because of the jet temperature range being analyzed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0028, SUPERSONIC WING-BODY ANALYSIS AND DESIGN

P.E. Rubbert, Boeing Co., *7555 E. Marginal Way S., Seattle, Washington* 98124 (DF139590; F33615-77-C-3051)

This work will be in support of designing and analyzing fighter aircraft becoming operational in the 1985 time frame. Many of these aircraft have geometrical shapes that present considerable difficulty in estimating aerodynamic properties. This includes calculations of the flow in and around the region of the engine inlet and over a highly blended wing/fuselage/inlet shape typical of advanced supersonic fighters. This effort will allow the aerodynamic properties of a vehicle to be estimated without running tunnel tests on impractical shapes. This will represent a substantial cost saving to the Air Force and will result in a computer program capable of computing the flow over highly complex aircraft shapes at supersonic speeds.

An advanced paneling method will be used to describe the aircraft to a computer program. This technique can be used to calculate the three-dimensional flow field about a complete aircraft. It is also amenable to the computation of internal flows such as ducts, inlets, and wind tunnels. This method will make use of source and doublet panels as the basic building blocks for geometrically describing the aircraft configuration. Output data would consist of pressures and velocities at all boundary points, three-component forces and moments, and streamlines both on the aircraft and in the flow field.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0029, ADVANCED EJECTION SEAT FOR HIGH DYNAMIC PRESSURE ESCAPE

R.F. Yurczyk, Boeing Co., *7555 E. Marginal Way S., Seattle, Washington* 98124 (DF143320; F33615-79-C-3406)

This work unit will support projected manned fighter aircraft designs in which expanding escape performance envelopes and integration of the escape systems with advanced cockpit configurations are critical problem areas. Current crew escape statistics reveal that approximately 45 percent of the ejections result in major or fatal injuries to the crew. The performance, mission profiles, maneuvering capabilities and design characteristics projected for future aircraft increase the potential for escape in more hazardous areas of the flight envelope. The objective of this work unit is to develop an advanced ejection seat escape system design capable of successful operation at dynamic pressures up to 1600 psf and functional compatibility with advanced cockpit designs. The emphasis on escape system performance will be stability, acceleration protection, wind blast protection and limb flail protection. The need to increase the safe crew escape capability applies to current fighters, near-term derivatives and the fighter configurations projected for the future.

Conduct a wind tunnel investigation and performance prediction analysis on selected ejection seat configuration concepts which were generated in a recently completed FY77 LDF program. Refine the configuration as required with emphasis on acceptable ejection loads on crew and on cockpit integration considerations. Fabricate a working mock-up to demonstrate wind blast protection, restraint and crew station integration techniques.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, TERNARY COORDINATION COMPLEXES OF METALS WITH 5' NUCLEOTIDES AND AMINO ACIDS IN A CLAY ENVIRONMENT

J.B. Orenberg, California State University & Colleges, San Francisco State University, School of Science, Dept. of Chemistry, *1600 Holloway Ave., San Francisco, California* 94132 (NAGW 94)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

3.0002, A COMPARATIVE STUDY OF CALCULATED AND OBSERVED MAGNETOSHEATH PLASMA PROPERTIES

J.R. Spreiter, Stanford University, School of Engineering, Dept. of Aeronautics & Astronautics, *Stanford, California* 94305 (NAGW 86)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

3.0003, STUDIES OF THE MAGNETO-TRANSPORT AND MAGNETO-OPTIC CHARACTERISTICS OF MOS INVERSION AND ACCUMULATION LAYERS

A. Madhukar, University of Southern California, School of Engineering, Dept. of Materials Science, *3551 University Ave., Los Angeles, California 90007* (DF051070; AFOSR-78-3530)

AF function - microwave electronic solid-state devices are essential components of Air Force reconnaissance, electronic countermeasures and communications systems. Deficiency - future system requirements demand improvements in power, frequency and efficiency. One of the most promising device configurations is the metal-oxide-semiconductor field effect transistor (MOS-FET). However, at present time not enough is understood concerning the various mechanisms which govern the electronic transport characteristics, and hence the performance of these devices. Objective- the objective of this research is to extend the theoretical and experimental work already being performed in silicon into the area of the III-V semiconductor system. Emphasis is to be placed on understanding the dependence of carrier mobility on various inversion layer parameters, their variation due to the influence of the parameters of the different III-V compounds and on the implications of various scattering mechanisms for mobilities in the inversion or accumulation layers of MOS-FET devices. How work contributes - this work will advance state-of-the-art by providing a better understanding of how material parameters influence device performance and ultimately by providing design criteria for devices with optimal performance characteristics.

A theoretical investigation of the scattering mechanisms which govern the transport characteristics of metal-oxide-semiconductor inversion layers will be conducted by testing the theoretical models with the available data (in the Si-SiO2 literature) and then extending these models to the III-V compound semiconductor systems. Specifically, with respect to both electron-electron and impurity scattering, it is not clear that the usual approximations for bulk (and hence 3-D) configurations are valid for the MOS inversion layer which is essentially a 2-dimensional system. The new model to be developed will take into account both the 2-D and carrier density variation problems, as well as electron-phonon interactions and the effects of a magnetic field. Parallel experimental efforts will be directed to measure the effective mass of electrons in inversion layers of III-V compounds by far infrared cyclotron resonance measurements and by d.c. magneto-conductance measurements. (Text Abridged)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0004, PROPAGATOR METHOD FOR MOLECULAR SYSTEMS

Y. Ohrn, State University System of Florida, University of Florida, College of Liberal Arts & Sciences, Dept. of Chemistry, *208 Tigert Hall, Gainesville, Florida* 32601 (DF038380; AFOSR-79-0032)

AF function - nuclear weapons effects. Deficiency - in order to predict the duration and intensity of the infrared background in a nuclear burst it is necessary to know the cross-sections for excitation of diatomic molecules. Objective - this research is concerned with development of propagator methods that will allow direct determination of absorption frequencies and intensities in molecular spectra and direct calculation of excitations or de-excitations and cross-sections in collision processes, without separate calculation of the state wave-functions. Contribution - propagator methods take information on atomic orbitals and energy levels and, without the introduction of any parameters, permit the calculation of molecular properties needed in weapons codes.

In this research the Green's function or propagator approach to molecular properties is being further developed and computer programs for implementation are being written and tested.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0005, HIGH TEMPERATURE MOLECULES AND MOLECULAR ENERGY STORAGE

W. Weltner, State University System of Florida, University of Florida, College of Liberal Arts & Sciences, Dept. of Chemistry, *208 Tigert Hall, Gainesville, Florida* 32601 (DF042010; AFOSR-76-2906)

AF function - rocket propulsion, electromagnetic weaponry. Deficiency - structural and spectroscopic information on molecular species found in high temperature systems such as wakes, plumes, nozzles, lasers and combustors is required for improved design features of Air Force systems. Objective - research includes optical and electron spin resonance (ESR) spectroscopy of molecular species and the spin-alignment of radicals at high magnetic fields and low temperatures. How work contributes - the optical and ESR spectra of high temperature species provide information of vibrational, electronic and magnetic energy levels which is useful in plume identification and suppression and in the development of advanced lasers. Spin-aligned radicals provide a potentially important source of advanced, high energy propellants.

Species are vaporized and trapped in solid argon matrices at 4-10 degrees K for the study of their optical and ESR spectra. Species to be examined include carbon molecules (C5, C6) silicon species (SiC, SiN, SiO2), the oxides, hydrides, fluorides and nitrides of the transition metals Mn, V, Fe, Cr, Ni and Yb, and Hf2 and HCl2. A molecular energy storage apparatus has been constructed to allow spin alignment of radicals at high magnetic fields and low temperatures and will be tested.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0006, ELECTRODEPOSITION OF POLYCRYSTALLINE AND AMORPHOUS SILICON FOR PHOTOVOLTAIC APPLICATIONS

R.D. Rauh, E I C Corp., Dept. of Research, *55 Chapel St., Newton, Massachusetts* 02158 (C-551; AC03-79ET23046)

The objective of this contract is to evaluate the reactions and optimize conditions for electrodepositing films of both amorphous and polycrystalline silicon which can be used in solar cell fabrication. Electrodeposition of silicon holds promise as a relatively inexpensive, energy efficient, and readily controllable method for thin film formation. Electrodeposition reactions will be studied in both molten salts and organic solvents. The program is designed to provide an understanding of the dependence of the physical, chemical, and electrical properties of the film on the electrodeposition conditions.

SUPPORTED BY U.S. Dept. of Energy, San Francisco Operations Office

3.0007, PROBLEMS IN THEORETICAL CHEMISTRY - ELECTRONIC STRUCTURE AND DYNAMICS OF MOLECULES IN VACUUM AND IN SOLUTION

M. Karplus, Harvard University, Cambridge Campus, School of Arts & Sciences, Dept. of Chemistry, *Cambridge Station, Cambridge, Massachusetts* 02138 (CHE79-20433)

This grant supports research under the Quantum Chemistry Program for applications of theoretical methods to chemical problems. Quantum mechanical methods of the ab initio and semi-empirical type will be employed to study the geometry, electronic structure, and dynamics of the ground and excited states of polyenes and related molecules. To determine the effect of a solvent on these molecules and their properties, quantum-mechanical calculations will be performed iteratively in the presence of a Monte Carlo and molecular dynamics averaged solvent system consisting of polarizable or dipolar Lennard-Jones particles. Necessary quantities will be evaluated and used for the calculation of energy term splittings and total energies of large molecules. The properties of water, aqueous solution, and native proteins will be studied by Monte-Carlo and molecular dynamics techniques. An objective of this research is to demonstrate the effect of solvent on protein dynamics and to test phenomenological models which are generally employed for interpretation of experimental measurements.

This is a renewal of research currently supported by NSF grant CHE7617569 at Harvard University.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0008, METHANOL AS A FUEL EXTENDER FOR STATIONARY GAS TURBINE COMBUSTORS

D.P. Hoult, Massachusetts Inst. of Technology, School of Engineering, Dept. of Mechanical Engineering, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (NCC 3-15)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

3.0009, THE MECHANISM OF FRETTING FATIGUE CRACK INITIATION IN STEELS

D.J. Duquette, Rensselaer Polytechnic Inst., School of Engineering, Dept. of Materials Engineering, *110 8th St., Troy, New York* 12181 (DA0U5576; DAAG29 76 C 0006)

To clarify the basic mechanism underlying the initiation of cracking under fretting-corrosion-fatigue in steels. Fretting and its ramifications in fretting-corrosion-fatigue have been of serious consequence in engine and rotating structural components of Army aircraft and such phenomena may be responsible also for some classes of problems in high rate-of-fire weapons.

Studies will be made of how certain variables, such as frequency, microstructure, relative hardness of surfaces, environment, temperature, and contacting surfaces, partake in the process of fatigue initiation in steels. From fretting fatigue studies conducted at constant strain conditions, quantitative information will be derived which will form the basis of a comprehensive theory for fretting-corrosion-fatigue of metals and alloys.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0010, STUDIES IN DEFORMATION AND FRACTURE 16361-MS

C.R. Manning, University of North Carolina, North Carolina State University, School of Engineering, Dept. of Materials Engineering, *Raleigh, North Carolina* 27607 (DA0G8902; DAAG29-78-G-0202)

The research will include: (1) a study of localized deformation and fracture in polymeric materials, with concentration on modification of existing deformation models to take into account the local structural and compositional factors that govern localized flow; (2) study of the relation of structural factors of polymeric foams to crack propagation in fatigue; and (3) determination of the corrosion-fatigue behavior of metal-matrix composites. Relevance - structural foams are planned for Army applications such as vibrational and shock damping in a wide variety of vehicular structures. The establishment of foam structure and its relation to dynamic mechanical properties of foams is essential to this work. Metal-matrix composites are planned for a variety of structural applications in bridging and helicopters.

(1) Molecular weight and crystallinity determinations in localized deformation regions will assist in establishing new heat transfer parameters and a basis for modification of existing deformation models. (2) Stereological studies of cellular structures in various types and densities of polymeric foams will be used as baselines for determining preferred crack paths in fatigue. (3) The corrosion fatigue behavior, as expressed by S-N and DA/DN data, will be developed for various classes of Al/G and other systems to determine the roles of environment, stress level, and other factors in fatigue crack resistance.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0011, CHEMICAL DYNAMICS AT THE GAS-SOLID INTERFACE - COLLISION-INDUCED ELECTRONIC TRANSITIONS

G. Wolken, Battelle Memorial Inst., *505 King Ave., Columbus, Ohio* 43201 (DF046010; F49620-77-C-0004)

AF function - this proposed research primarily falls in the 6.3 research objectives which deal with the development of high energy lasers. The specific problem under consideration will be the dynamics of reactions occurring at the gas-solid interface. A novel pumping mechanism for infrared lasers could result from this study, and the subsequent developments and refinements will have important technological consequences. Deficiency - in the development of any laser the main step is to achieve the correct population inversion of the system. With the large variety of possible gas-solid interactions (including various crystal faces and alloys), a preliminary computer screening to identify necessary characteristics for population inversion is needed to provide valuable guidelines for experimentation. Objective - the present proposal addresses two extensions of the model: (1) the role of surface atom motion in determining desorption dynamics, (2) the specialized energy requirements for adsorption and how the adsorption process affects the momentum distribution of the adsorbed particles. Contribution - this research is a part of a comprehensive program in statistical mechanics.

Using computer simulations, it is proposed to study the energy requirements (vibrational, rotational and translational) for adsorption of a gas-phase molecule on a solid surface. The role of the gas-solid potential for different types of surfaces and various lattice dynamics for the surface atoms will be investigated. The importance of these effects in promoting adsorption will be assessed. Battelle researchers have developed a model to describe the interaction of diatomic and triatomic gas molecules with solid surfaces. Work currently in progress at Battelle under AFOSR sponsorship is using this model to investigate the dynamics of recombination and desorption of adsorbed atoms to elucidate conditions under which useful amounts of vibrational energy will appear in desorbing molecules. The present proposal addresses two extensions of the model: (1) the role of surface atom motion in determining desorption dynamics, (2) the specialized energy requirements for adsorption and how the adsorption process affects the momentum distribution of the adsorbed particles. This, in turn, affects the desorption dynamics and, hence, the feasibility of obtaining useful amounts of vibrational energy.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0012, THE ROLE OF HYDROGEN IN THE STRESS CORROSION CRACKING OF HIGH STRENGTH ALUMINUM ALLOYS

L.M. Bernstein, Carnegie Mellon University, Carnegie Inst. of Technology, Dept. of Metallurgical & Materials Science, *Frew Ave. & Margaret Morrison, Pittsburgh, Pennsylvania* 15213 (DF046820; F49620-77-C-0003)

AF function - hydrogen embrittlement is a serious problem that causes mechanical property degradation in our most significant aircraft materials, including steels, titanium, aluminum and nickel-base alloys. Opportunity - hydrogen-related phenomena are suspect of playing key roles in the mechanisms of stress corrosion cracking, subcritical crack growth, hot salt corrosion, weld cracking, temper embrittlement, fatigue crack growth, and brittle fracture in general. Objective - this investigation will identify the role played by hydrogen in stress corrosion cracking of high strength aluminum alloys through determination of microstructural and fractographic correlations with cracking, direct observations of cracking, permeation studies, and mechanical tests under cathodic charging conditions. How work contributes - the various forms of hydrogen-related mechanical property degradation severely restrict the serviceability of our important aircraft materials. Basic understanding of the manner by which hydrogen acts to reduce mechanical strength and cause failures is important if we are to minimize and control these forms of attack.

Specific emphasis will be placed on the role of metallurgical variables such as precipitate type, size and distribution, to develop these as control variables for the production of high strength aluminum alloys (7000-series) more resistant to hydrogen embrittlement and/or stress corrosion cracking.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0013, CHEMICAL AND PHYSICAL ASPECTS OF MESOPHASE FORMATION DURING CARBON-CARBON COMPOSITE PROCESSING

J.J. Gebhardt, General Electric Co., *3198 Chestnut St., Philadelphia, Pennsylvania* 19101 (DF050380; F49620-78-C-0006)

AF function - advanced strategic missile systems will employ carbon-carbon structural composite materials for nozzles and nose-tips. Deficiency - the relation of the important microstructural features which determine properties and performance of composites to the physiochemical processes taking place during pressure pyrolysis are unknown. Objective - the objective of this research is to develop a fundamental understanding of the chemistry of formation of the graphite matrix precursor (mesophase) during pressure pyrolysis under simulated fabrication conditions. How work contributes - this research will contribute to the systematic development of a process chemistry base which will permit tailoring of the carbon-carbon processing cycle to obtain desired microstructures for achieving improved thermochemical and thermostructural response.

(1) The determination of viscosity, density, compressibility and other fundamental properties of a model compound such as phenanthrene and a typical commercial pitch as a function of processing temperatures, times and pressures. (2) The determination of the influence of pressure on the formation and characteristics of mesophase derived from a model compound and a commercial pitch in various time-temperature regimes. (3) The determination of the influence of carbon fiber surfaces and structural chemistry on mesophase formation. (4) Characterization of the physical and chemical aspects of graphitization of the mesophase formed during the aforementioned studies.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0014, X-RAY PHOTOELECTRON SPECTROSCOPY (XPS) AND SECONDARY ION MASS SPECTROMETRY (SIMS)

N. Winograd, Pennsylvania State University, University Park Campus, Graduate School, *205 Kern Graduate Bldg., University Park, Pennsylvania* 16802 (DF056420; AFOSR-80-0002)

AF function - flight operations, communications and life support depend on auxiliary battery sources for power. Deficiency - there is a continuous need to attain longer life, higher energy, and lighter weight batteries to meet power requirements. Objective - research deals with the understanding of the surface chemistry of the electrode and how the chemistry influences the resulting electron transfer process. It exploits X-ray photoelectron spectroscopy (XPS) and secondary ion mass spectrometry (SIMS) to elucidate electrode processes. How work contributes - it is hoped to demonstrate that XPS/SIMS is a powerful tool for electrochemists for providing new information on corrosion process, electrocatalyst and fuel cell technology.

It is planned to characterize the chemical composition of modified electrode surfaces by examining the chemical shift of core level electron binding energies for various species which may be present in the first 20-30 A of the electrode surface. The SIMS results will be analyzed in terms of the composition of molecular cluster ions ejected from the electrode surface. The approach should be applicable to metal oxides, alloys and organic films.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0015, LOW TEMPERATURE FLUORINE CHEMISTRY OF ELECTRONEGATIVE ELEMENTS

G. Mamantov, University of Tennessee, Knoxville Campus, School of Liberal Arts, Dept. of Chemistry, *W. Cumberland Ave. S.W., Knoxville, Tennessee* 37916 (DF046520; AFOSR-77-3165)

AF function - future Air Force space explorations require improved propulsion and power systems. Deficiency - new synthesis techniques for preparing more energetic materials are needed. Objective - the research involves cryogenic synthesis of strongly oxidizing species of fluorine and other electronegative elements. How work contributes - the research will provide new approaches to the synthesis of high energy materials.

The following approaches to cryogenic synthesis will be explored -a) the use of a carbon dioxide infrared laser and uv photolysis for excitation of low temperature and gas phase reactions involving compounds with N-F and O-F bonds as well as fluorine. This approach will be used to explore synthetic routes to BF4 plus salts, such as NF4BF4; b) the use of UV photolysis for the production of new radicals; and c) radical-radical reactions in matrices. The characterization of products will be carried out by Fourier transform infrared spectroscopy.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0016, IMPROVE TURBINE ENGINE LUBRICANT

B.B. Baber, Southwest Research Inst., *8500 Culebra Rd., P.O. Drawer 28510, San Antonio, Texas* 78228 (DA0P3629; DAAK70 78 C 0001)

Develop improved turbine engine lubricant having increased load-carrying capacity and capable of operating at higher temperatures without sacrificing other performance characteristics.

A coordinated Army, Navy, and Air Force effort is being made to determine the degree of lubricant improvement needed considering both Army helicopter turbine engines and the new AGT 1500 tank engine. High-temperature gear/lubricant tests will be conducted as new high-hot-hardness gear materials become available.

SUPPORTED BY U.S. Dept. of Defense, Army, Mobility Equipment Research & Development Command

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, GRADUATE STUDENT RESEARCHERS PROGRAM

G.R. Karr, University of Alabama in Huntsville, School of Science & Engineering, *Huntsville, Alabama* 35807 (NGT 01-002-083)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

4.0002, ROLE OF MICROSTRUCTURE IN EPITAXIAL REGROWTH IN METAL-SEMICONDUCTOR INTERFACES

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To study the mechanism of solid-phase epitaxial regrowth in metal-semiconductor systems. Relevance - the research is relevant to processing of silicon for integrated circuits which are used in a multitude of Army electronics components for communications, signal processing, computers, etc. It is also relevant to the understanding of the behavior of integrated circuits subjected to radiation environments.

The program will include (1) Growth of Al/Si structures. (2) Ion implantation of Al and protons in Al film; protons, Si, B, as in Si film; Si, B, as in Si film to create amorphous Si. (3) Characterization of specimens using TEM/TED/SEM, AES. (4) Measurement of I-V and C-V characteristics.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0003, RESEARCH IN SOLID-STATE ELECTRONICS

R.W. Gould, California Inst. of Technology, Graduate School, Dept. of Applied Physics, *1201 E. California Blvd., Pasadena, California* 91109 (DA0F8958; DAAG29 77 C 0015)

Research to understand the physics, and to structurally and electronically characterize different layers of electronically active materials. The research will focus on interfaces between and surfaces of semiconducting materials. Relevance - a major portion of the electronic devices used in Army applications is

derived from multilayers or heterojunctions of electronically active materials. This program will effectively contribute to the very important science and technology base of integrated circuits, millimeter- and micro-wave devices and night vision systems.

A theoretical and experimental investigation of (1) properties of abrupt GaAs/AlAs interfaces theoretically by LCAO (linear combination of atomic orbitals) treatment and experimentally by optical means; (2) low temperature epitaxial microtransport growth and characterization of heterojunctions; and (3) properties of surface layers exposed to ion implantation by channeling backscatter spectroscopy.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0004, ULTRA-HIGH SPEED SWITCHING DEVICES AND CARRIER DYNAMICS IN SEMICONDUCTORS

A. Yariv, California Inst. of Technology, Graduate School, Dept. of Electrical Engineering, *1201 E. California Blvd., Pasadena, California* 91109 (ECS79-16915)

The temporal electronic properties of gallium arsenide-related thin films and thin film electronic devices is under investigation using picosecond laser techniques. The study focuses on carrier dynamics in ternary and quarternary compounds containing aluminum and indium phosphide in addition to gallium arsenide. Hot carrier excitation, diffusion, and recombination properties are measured using short pulse probes and impressed magnetic fields to separate bulk from surface properties. The dynamical properties of semiconductor lasers are also being studied using carrier injection by voltage pulsers energized by a picosecond pulse dye laser.

This is the first year of a 2-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0005, WORLDWIDE PERFORMANCE OF TACTICAL MILLIMETER WAVE RADIO LINKS

S.J. Dudzinsky, Rand Corp., *1700 Main St., Santa Monica, California* 90406 (DA0F2854; DAAB07-77-C-0142)

The objective of this study program is to investigate the environmental performance of tactical millimeter wave transceivers operating in frequency bands from 35 GHz through 75 GHz, with voice, TV and data communications.

Using available worldwide rainfall data, calculations will be performed on radio fading, link performance, maximum range, outage/availability. Automated techniques for increasing link availability will be investigated by analyzing various operating parameters - power transmission, space, time/frequency diversity techniques, or a combination thereof. An investigation will be made of whether an enemy can use satellite meteorological data, airborne/ground weather radar data/sensor information, to determine if Army millimeter wave radio outages exist in order to gain tactical advantage.

SUPPORTED BY U.S. Dept. of Defense, Communications Research & Development Command, Center for Communications Systems

4.0006, DEVELOPMENT OF HIGH EFFICIENCY GAAS POLYCRYSTAL SOLAR CELLS

J.S. Harris, Rockwell International Corp., Dept. of Solid State Electronics, *1049 Camios Dos Rios, Thousand Oaks, California* 91360 (EG-77-C-03-1712)

The objective is to develop basic technology to produce greater than 10% efficient GaAs thin film polycrystal solar cells with potential for very low cost, large scale production. The approach involves developing a fundamental understanding of the physics of grain boundaries and the mechanisms by which they limit solar cell performance. Polycrystal growth techniques, solar cell designs and fabrication techniques which minimize the impact of grain boundaries and polycrystal materials on cell performance are being studied. The expected results include a detailed microscopic model of grain boundary effects; crystal growth and fabrication techniques which neutralize grain boundaries; high spatial resolution analytical techniques for characterization and process control; device optimization for low cost, thin film solar cells; and demonstration of greater than 10% efficient devices.

SUPPORTED BY U.S. Dept. of Energy, Div. of Solar Technology

4.0007, AEROELASTIC OPTIMUM DESIGN OF LIFTING SURFACES WITH ACTIVE CONTROLS

L.A. Schmit, University of California, Los Angeles Campus, School of Engineering & Applied Science, Dept. of Engineering, *405 Hilgard Ave., Los Angeles, California* 90024 (DF054030; F49620-79-C-0018)

AF function - advanced flight vehicles will require maximum efficiency from all on-board systems. Opportunity - optimization techniques have been demonstrated for static structural behavior but have not been fully considered for aeroelastic responses in conjunction with active control systems. Objective - the objective of this research is to develop an efficient and accurate solution technique for the aeroelastic behavior of minimum weight structures with active controls. How work contributes - the research contributes to the goal of achieving a fully automated optimum design procedure for aircraft.

Highly efficient modern aircraft are designed for maximum flight efficiency and minimum weight. Initially, all strength conditions are satisfied by the design. Subsequently, flutter margins are analyzed with either stiffness increases or mass balancing utilized. In addition, recent developments have used active flight control systems to suppress flutter. This research will expand minimum weight optimization methods to consider aeroelastic phenomena and active control techniques. Two basic approaches will be followed by this effort: first, a serial approach in which all parameters are considered sequentially; second, a parallel treatment of the parameters. Each approach will be considered in solving high and low aspect ratio wing problems for supersonic and subsonic aerodynamic conditions respectively. Solutions and solution procedures will be compared in terms of accuracy and computational efficiency.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0008, SHOCK-TUBE STUDIES OF IMPORTANT REACTION STEPS INVOLVING CF3BR FOR THE INHIBITION OF HYDROCARBON COMBUSTION PROCESSES IN AIR

K.G. Sulzmann, University of California, San Diego Campus, Graduate School, *P.O. Box 109, La Jolla, California* 92037 (DA0G0870; DAAG29-80-C-0001)

To investigate the phenomena of reactions involving CF3Br behind reflected shock waves re the inhibition of hydrocarbon combustion in air at temperatures between 1500 and 2200 degrees K and at pressures between one and two atmospheres. Studies will include: CF3Br-pyrolysis in argon-diluted systems as well as chemical interactions of CF3Br with O, O2, CJ4, H2CO, H, H2O and CH3. Relevance - the Army has extensive programs on the development of fire-safe fuels to which this research will contribute important fundamental work. This work bears upon fire-arresting systems for electronic computer facilities as well as arresting fires in many weapons systems inside tank compartments.

Analytical and computer analyses of the reaction schemes will be used to generate synthetic concentration-time profiles and will be combined with the experimental data to obtain reaction rate coefficients for the dominant reaction steps.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0009, PYROELECTRICITY IN EXTREMELY THIN SAMPLES FOR IMPROVED HIGH SPEED INFRARED DETECTORS

M. Bass, University of Southern California, School of Engineering, Dept. of Electrical Engineering, *3551 University Ave., Los Angeles, California* 90007 (DA0F9041; DAAG29-79-C-0111)

To gain a better understanding of pyroelectricity in thin samples, which should lead to a better understanding of pyroelectricity in other geometries. In addition, obtain a potentially improved fast response pyroelectric detector. Relevance - this program has relevance for both the low energy and high energy laser programs since all the schemes which are considered for countermeasuring lasers involve detection utilizing detectors which must be fast, uncooled, broadband and damage-resistant. Such detectors are a potential outgrowth of the proposed research.

Studying the pyroelectric response in very thin samples against the concept of a limited phonon transit time.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0010, ELECTROMAGNETIC SCATTERING PROCESSES AT RESONANCE AND WITH INTENSE FIELDS

R.W. Hellwarth, University of Southern California, School of Engineering, Dept. of Electrical Engineering, *3551 University Ave., Los Angeles, California* 90007 (DF054890; AFOSR-79-0098)

AF function - there is a critical need to find means to eliminate deleterious effects of phase distortion of laser beams being considered for weaponry, reconnaissance and other vital AF functions. Opportunity - nonlinear phase conjugation techniques offer a means to automatically correct phase distortion of optical beams caused by the atmosphere, imperfect optics or other phenomena. These techniques must be better understood, their limits explored and novel implementations considered before they can be applied to important AF problems. Objective - study nonlinear phase conjugation by Brillouin scattering including reduction of threshold using near resonant phenomena, effects of linear loss and geometric effects. Contribution - this work will supply understanding necessary to apply stimulated brillouin scattering phase conjugation techniques to prevent distortion in AF optical systems.

The approach is mainly theoretical but will include some experimental verification. The effect of linear loss, especially in wave-guides, on the stimulated Brillouin backscattered efficiency will be formulated and calculated. Ultimate limits imposed by such processes will be studied. Resonance enhancement of phase conjugation by stimulated Raman or Brillouin scattering will be theoretically studied and experiments using dye lasers to excite dyes in wave-guides will be used to verify theory. Short pulse (transient) effects will be explored. Possibilities of using polarization effects for nonlinear spectroscopy, especially at low frequencies determined by the difference in input optical frequencies, will be explored.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0011, FUNDAMENTAL PROBLEMS IN HIGH ALTITUDE AERODYNAMICS

E.P. Muntz, University of Southern California, School of Engineering, Dept. of Aerospace Engineering, *3551 University Ave., Los Angeles, California* 90007 (DF014950; AFOSR-77-3142)

AF function - weaponry, propulsion and power, aerospace vehicles. Deficiency - lack of knowledge of vibrational and rotational energy distribution in nonequilibrium expansions from excited states in laser cavities and rocket plumes. Objective - to characterize nonequilibrium nozzle expansion flows of vibrationally and rotationally excited carbon monoxide, to determine the populations of the various quantum levels, and to determine the influence on these observations of the various rarefied plume parameters. How work contributes - this knowledge will be useful in understanding processes in gas lasers as well as in high altitude rocket plumes.

Electron beam fluorescence will be used to measure nitrogen vibrational population distribution in mixtures with carbon monoxide and with argon in a discharge tube. Translational temperature and mixture ratio will be varied. In order to infer, in addition, the vibrational population distribution in the carbon monoxide, it will be calculated from the measured nitrogen distribution and the measured rotational temperature using the energy transfer model of Caledonia and Center. This procedure will then be verified by observing the agreement between predicted and measured gain coefficients for those cases where gain is found. Direct measurement of vibrational distribution in carbon monoxide by electron beam fluorescence has proven unfeasible.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0012, MAGNETIC FIELD INTERACTIONS WITH MATERIAL DISCONTINUITIES

W. Lord, Colorado State University, School of Engineering, Dept. of Electrical Engineering, *Fort Collins, Colorado* 80523 (DA0E9194; DAAG29-78-G-0143)

To model the interaction of magnetic fields with material discontinuities using finite element analysis techniques. Relevance -the research is relevant to nondestructive evaluation of steels used in such components as gun tubes, munitions, pipes, aircraft, etc. to detect inclusions, voids and cracks. It is also relevant to the design of magnetic ordnance and communication devices where geometry and spatial distribution of magnetic fields are important. The computer codes to be generated as a result of the research will be made available to Army scientists, and this is relevant to processing of data in various R & D programs in Army laboratories.

The program will include development of magnetic leakage field profiles for a variety of surface and subsurface defects in an axially magnetized ferromagnetic bar; measurement of magnetic leakage fields around actual defects using Hall plates, and comparison of results with theory; extension of models to include residual forms of magnetization; and study of the feasibility of using finite element analysis to model eddy current interactions with material discontinuities.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0013, INVESTIGATION OF DISTRIBUTED MICROCOMPUTER METHODS FOR HIGH AUTHORITY AUTO FLIGHT SYSTEMS

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SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

4.0014, CRITICAL REVIEW OF RECENT RUSSIAN SCIENTIFIC LITERATURE ON FLOW SEPARATION

P.K. Chang, Catholic University of America, School of Engineering & Architecture, Dept. of Civil & Mechanical Engineering, *620 Michigan Ave. N.E., Washington, District of Columbia* 20017 (DF052660; AFOSR-78-3636)

AF function - advanced aerospace vehicles. Deficiency - lack of basic knowledge about various aspects of flow separation on general flight vehicle configurations across the speed regime. Objective - to evaluate recent Russian contributions to the field of flow separation and to disseminate this information to the US scientific community. How work contributes - by evaluating the original Russian contributions in the field of flow separation in light of research underway in the west and also by providing a means to disseminate the information, this work will help advance the state of knowledge, help eliminate unnecessary duplication of effort, and provide a firmer foundation for continuing research.

A critical review will be made of the most significant of the 300 recent Russian papers referenced in 'New Results of Separated Flow Studies,' NASA TTF 117, $30, as well as two books in process of being translated, 'Gradient and Separated Flows' (1976) edited by S.S Kutateladze and 'Gas Dynamics of Near Wake' (1976) by A.I. Shvets and I.T. Shvets. These references will be evaluated in light of approaches followed and results obtained by western researchers working in related areas.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0015, STABILITY AUGMENTATION SCALING
R.L. Fanin, General Motors Corp., *4700 W. 10th St., Indianapolis, Indiana* 46206 (DF457340; F33615-75-C-2044)

The objective of this effort is to establish the usefulness of local metal matrix composites to increase the vibration stability of fan/compressor blades.

This program consists of five tasks. Task I is a design and analysis effort to parametrically define the influence of locally stiffening turbine engine fan/compressor blades using metal matrix composite inlays. Task II establishes the manufacturing processes to produce a low-cost, reproducible blade. Task III includes the fabrication of fan/compressor blading with the composite panel inlays. Task IV emphasizes the verification of frequency, mode shape and strength characteristics using Task III hardware. Task V covers the instrumentation, assembly and piggyback engine testing of a full stage of composite inlaid blades. Additional AMST and experimental flight testing is scheduled to structurally verify the Ti metal matrix in the engine environment.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0016, DETERMINATION OF EJECTION SEAT/MAN AERODYNAMIC PARAMETERS
D.C. Chiang, Rose Hulman Inst. of Technology, School of Engineering, Dept. of Mechanical Engineering, *5500 Wabash Ave., Terre Haute, Indiana* 47803 (DF058220; AFOSR-80-0147)

AF function - advanced aerospace vehicles. Deficiency - inadequate methods are available for predicting the aerodynamic parameters for ejection seat/man configurations. Objective - to carry out the adaptation of the Mark IV computer code for supersonic-hypersonic flow past arbitrary bodies to the case of ejection seat/man configurations. How work contributes - will provide an engineering level analysis tool which will help overcome the deficiency noted.

Pressure probes and hot wire anemometry will be used to obtain data on low speed flow past an axisymmetric body (hemispherical nose with hemispheriodal rear section) at angle of attack. Mean and fluctuating velocity measurements will be taken in the attached boundary layer, while a five-hole Pitot probe will be employed in the thick boundary layer region near vortex formation. A special three-hole yaw probe resting on the surface will be used to determine the direction of the wall shear stress. An alternating direction, implicit three-dimensional computational procedure for boundary layer flows, will be extended to cases in which large and reversing cross-flows occur, as well as to cases in which the boundary layer degenerates into a vortical flow.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0017, PREDICTION OF SEPARATING TURBULENT BOUNDARY LAYERS INCLUDING REGIONS OF REVERSED FLOW
R.R. Pletcher, Iowa State University of Science & Technology, School of Engineering, Dept. of Mechanical Engineering, *496 Town Engineering Bldg., Ames, Iowa* 50011 (DA0E9042; DAAG29 76 G0155)

To develop and evaluate improved methods of predicting incompressible turbulent boundary layer flow in the neighborhood of separation including the region of recirculation downstream of the separation point. This research is directly relevant to studies at the Ames Directorate of AMRDL concerning helicopter rotor aerodynamics and to studies at the MICOM concerning missile control and chemical laser flows.

The iterative calculation procedure recently developed for computing past the separation point in laminar flow will be adapted to turbulent flow initially using a simple mixing length model of turbulence.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0018, PLASMA EMISSION SPECTROMETRY TECHNIQUE DEVELOPMENT
R. Winge, U.S. Dept. of Energy, Ames Lab., *Ames, Iowa* 50010 (D9-X0584; KC37 -116)

OBJECTIVE: This will continue the development of plasma-source emission spectrometry as a rapid, sensitive technique for multielement analysis. Attention will be given to lowering detection limits and eliminating interferences. Nebulization techniques for introducing aqueous samples will be refined and a scanning monochromator will be evaluated.

APPROACH: Vidicon detection will be evaluated for rapid multielement analysis with the plasma as the source of optical emission.

PROGRESS: Studies of torch height profiles have been made in an effort to determine the value of either multiple torch height settings or a system that focuses more than one area of the plasma into the spectrometer. Some preliminary studies have begun on a microjet injection system to attain more desirable detection limits.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Research Lab.

4.0019, COMPUTATION OF THREE-DIMENSIONAL AERODYNAMIC FLOW
K.C. Wang, Martin Marietta Corp., *1450 S. Rolling Rd., Baltimore, Maryland* 21227 (DF044900; F49620-76-C-0004)

AF function - the design of reentry vehicles. Deficiency - no efficient method exists for computing complete flow fields past 3-D bodies at angles of attack. Objective - this research intends to develop efficient numerical and computational schemes for solving 3-D Navier Stokes equations of flows past bodies at angles of incidence. How work contributes - techniques developed may be used in conjunction with wind tunnel data for the design of reentry and aerospace vehicles.

This effort will investigate the solution of unsteady, three-dimensional, compressible, laminar Navier-Stokes equations by the use of an implicit splitting method which incorporates the unconditionally stable Crank-Nicolson schemes for the viscous flow and the basic Lax-Wendroff concept for the inviscid flow. Implementation in the form of a computer code for a UNIVAC 1108 computer. The actual computations will be performed using GFE computer at Edgewood Arsenal.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0020, ESTIMATION OF WATERSHED HYDRAULIC LENGTH USING REMOTE SENSING
R.N. McCuen, University of Maryland, College Park Campus, School of Engineering, Dept. of Civil Engineering, *College Park, Maryland* 20742 (NGT 21-002-800)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

4.0021, COMPUTER-BASED INTERACTIVE FLIGHT TRAINING
W. Feurzeig, Bolt Beranek & Newman Inc., *50 Moulton St., Cambridge, Massachusetts* 02138 (DF052190; F49620-78-C-0066)

AF function - this research impacts future AF aircrew training programs. Deficiency - continued flying hour curtailments and projected restrictions on aircrew training as we know it today require the development of innovative training technologies for the future. Better performance measurement algorithms are needed and more optimal use of computer-based training for transition and continuation training programs in flight simulators are required. Objective - this research will investigate computer-implemented algorithms as new approaches to flight performance analyses expressely designed for interactive application in computer-based simulators. How research contributes -more effective aircrew training in flight simulation devices should occur as a result of this research.

This research employs state-of-the-art semantic representation and pattern recognition methods for extracting significant features of task performance by the aircrew member. Knowledge of the methods used by expert instructors in analyzing task

performance and malperformance behaviors will be used in procedures for parsing flights, defining segments and transitions, recognizing and characterizing errors and error patterns, diagnosing underlying trainee difficulties, and prescribing remedial training tasks to overcome task difficulties. The Orly simulator will be used for data collection from expert instructors. Instructor models will be created to determine ways of generating diagnostic and prescriptive procedures for the trainee.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0022, LITHIUM INORGANIC ELECTROLYTE BATTERY INVESTIGATION

M. Slavin, GTE Sylvania Inc., *Needham Heights, Massachusetts* 02194 (DF461350; F33615-77-C-2021)

Provide technology for safe, lithium inorganic electrolyte batteries which meet the performance requirements of life support, spacecraft, and missile silo applications.

Define the conditions and causes of lithium inorganic electrolyte battery explosions. Eliminate the above causes or establish a range of parameters under which safe operation can be achieved. Establish shelf life for both anode and cathode limited cells. Investigate sulfuryl chloride in addition to thionyl chloride as an electrolyte solvent/reactant.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0023, CONCEPTUAL DESIGN OF AN ENGINEERING TEST FACILITY SUPERCONDUCTING MAGNETOHYDRODYNAMIC MAGNET SYSTEM

P.G. Marston, Massachusetts Inst. of Technology, Graduate School, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (NAG 3-100)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

4.0024, CURRENT PROBLEMS IN TURBOMACHINERY FLUID DYNAMICS

E.M. Greitzer, Massachusetts Inst. of Technology, School of Engineering, Dept. of Aeronautics & Astronautics, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (DF040230; F49620-78-C-0084)

AF function - advanced turbomachinery. Opportunity - improvement of present-day operation of axial flow turbomachinery at the design point, off-design and decreasing the influence of inlet distortions. Objective - research will be performed to increase the performance and stability of gas turbine engines. How work contributes - the understanding of three-dimensional flows through axial turbomachinery under realistic conditions will enable one to design more efficient and stable equipment.

Both theoretical and experimental work will be performed toward 1) the formulation of design procedures using three-dimensional transonic codes and the development of a new non-intrusive laser velocimeter, 2) the investigation of compressor flow field instabilities and the mechanisms for stability enhancement, including the fluid dynamics of rotor case treatment and the development of three-dimensional stall prediction methods, and 3) the investigation of turbojet oepration in inlet flow distortion, including both inlet (ground) vortex distortions and combined radial peripheral total pressure distortion.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0025, MATERIALS PROCESSING IN SPACE EXPERIMENT - THE INFLUENCE OF GRAVITY ON THE SOLIDIFICATION OF MONOTECTIC ALLOYS

A. Hellawell, Michigan Technological University, Graduate School, *Houghton, Michigan* 49931 (NAS 8-33727)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

4.0026, INP METAL CONTACTS

G.Y. Robinson, University of Minnesota, Minneapolis Campus, School of Engineering, Dept. of Electrical Engineering, *105 Morrill Hall, Minneapolis, Minnesota* 55455 (DF903750; F19628-77-C-0204)

AF function - communications. Deficiency or opportunity - the properties of metal contacts on indium phosphide are inadequate and the mechanisms involved not well understood presently. Objectives - to develop an understanding of the electrical and metallurgical properties of the metal/InP system that will enable a superior contact to be formed. How research contributes - an understanding of the metal/InP interface will allow proper design of detectors operating beyond .94 (microns) for fiber optic communications systems.

Auger electron spectroscopy combined with barrier energy measurements, contact resistance measurements, and visual evaluation by scanning electron spectroscopy will be used to obtain metallurgical, chemical and electrical analysis of the metal/InP interface.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0027, DYNAMIC COUPLING OF BOUNDARY-FITTED COORDINATE SYSTEM WITH THE NAVIER-STOKES EQUATION

J.F. Thompson, Mississippi State University, School of Engineering, Dept. of Aerophysics & Aerospace Engineering, *Suite 101 Engineering Bldg., Mississippi State, Mississippi* 39762 (DA0F9292; DAAG29-80-C-0078)

To develop a finite difference numerical technique for the time-dependent, two-dimensional, incompressible Navier-Stokes equations for high Reynolds number flow about bodies of arbitrary shape. Relevance -the work is directly relevant to the prediction of flow fields about helicopter blades and fuselages, missiles and projectiles, and will therefore contribute towards better design procedures for these Army systems.

The solution technique will dynamically couple the coordinate system with the flow solution so that coordinate lines will concentrate automatically in the boundary layer and wake regions as the flow develops. The solution will incorporate an algebraic turbulent eddy viscosity model.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0028, FUNDAMENTAL RESEARCH IN TURBULENT MODELING

C. Donaldson, Aeronautical Research Associates of Princeton Inc., *50 Washington Rd., Princeton, New Jersey* 08540 (DF042850; F44620-76-C-0048)

AF function - advanced aerospace vehicles. Opportunity - to provide more complete modeling of complex turbulent flow fields. Objective - to increase the physical realism of turbulent shear flows by including the anisotropy of the strain rates on the flow fields, this is a method of retaining the turbulent structure for ensemble-averaged equations. How work contributes - understanding how the structure of turbulence affects the transport properties of a turbulent shear flow and how they can be introduced into the analytic prediction of aerodynamic forces will enhance our ability to correctly design advance vehicles and predict their performance.

A combined effort of experiment and analysis will be followed. Measurements of two-point velocity correlations will be taken in a vortex tube tunnel on flows with strong streamline curvatures by Dr. Bilanin. These data will be used to improve the second-order closure modeling of the tensor scale equations for the two-point velocity correlations by Dr. Sandri. These models will be tested against other turbulent shear flows as well as modeling of chemically mixing and reacting flows.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0029, MULTIPLE IGNITION, NORMAL AND CATALYTIC COMBUSTION, AND QUENCHING OF FUEL-AIR MIXTURES

F.V. Bracco, Princeton University, School of Engineering & Applied Sciences, Dept. of Aerospace & Mechanical Science, *Box 430, Princeton, New Jersey* 08540 (DF044300; AFOSR-76-3052)

AF function - weapon delivery and defenses, transport, advanced air-breathing engines, aircraft vulnerability and survivability. Deficiency - insufficient understanding of the basic physical, chemical, and fluid dynamic processes of (1) multiple ignition, propagation, and quenching of flames in spray-air mixtures, and (2) ignition, stability, and efficiency of catalytic combustion. Lack of guidelines for predicting potential flame/detonation quenching techniques and catalytic combustor performance and for solution of existing combustor difficulties. Objective - to clarify the relative importance, and to formulate realistic analytical representation of (1) the mechanisms of multiple ignition by hot metal particles, flame propagation and quenching in fuel-air sprays occurring in air-breathing propulsion system dry bays and fuel tanks, and (2) homogeneous, heterogeneous kinetics and transport processes in catalytic combustion phenomena associated with advanced air-breathing combustion systems. How work contributes - will provide additional understanding and needed realistic analytical modeling of multiple ignition, and flame propagation and attenuation through air-foil sprays and of homogeneous and heterogeneous high-temperature catalytic combustion processes not now available. Will contribute to establishing realistic guidelines and techniques for minimizing ignition probability and maximizing flame quenching and attenuation and for the design of efficient, stable, jet engine catalytic combustors.

Theoretical and experimental studies will be made of basic fluid dynamic, physical and chemical processes of ignition of hydrocarbon fuel sprays by clouds of hot metal particles acting as multiple ignition sources and associated combustion, detonation, and quenching in aircraft fuel tanks and dry bays, and of catalytic combustion associated with air-breathing propulsion systems. The relative importance of gas phase kinetics, heat transfer, mass diffusion, and surface chemical kinetics will be assessed. The practical phenomena will be experimentally simulated. The occurrence or absence of ignition of combustible gas and liquid fuel droplets by metal particles will be measured as a function of metal particle size, temperature, and gas and liquid phase composition. Deficiencies in existing mathematical models will be demonstrated and improved models formulated based on experimental data. (Text Abridged)

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

***4.0030, ENGINEERING AND INSTRUMENTATION* SUPPORT FOR ROCKET AND BALLOON LAUNCH OPERATION**

R.A. Bumgarner, New Mexico State University, Las Cruces Campus, School of Arts & Sciences, Dept. of Chemistry, *University Park, Las Cruces, New Mexico* 88003 (DF247520; F19628-76-C-0171)

AF function - command, control and communications. Deficiency -reduced effectiveness for supporting research rocket firings at WSMR and research balloon launches at Holloman AFB. Objective - to provide effective engineering and instrumentation support during the launching of scientific rocket and balloon payloads at WSMR and Holloman AFB. How research contributes - the instrumentation systems developed allow the aerospace investigations to be conducted on a timely and cost-effective basis. Projects depending on this research include 1366, 6687, 6688, 6690, 7659, and 7670.

The technical approach includes integrating range safety, tracking and recovery systems into rocket payloads to be launched in support of various scientific programs. A telemetry facility will be maintained and operated to provide for the prelaunch testing of the instrumented research rockets to be launched at WSMR. Approach also provide for equipment calibration and data analysis during balloon launches at Holloman AFB, New Mexico. Coordination will be provided between the instrumentation engineers and the launch sites to satisfy documentation or other technical interface requirements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

4.0031, STUDY OF THE PHOTOVOLTAIC EFFECT IN THIN FILM BARIUM TITANATE

W.W. Grannemann, University of New Mexico, School of Engineering, Dept. of Electrical Engineering & Computer Science, *University Hill N.E., Albuquerque, New Mexico* 87106 (NAG 1-95)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

4.0032, INVESTIGATION OF MOLECULAR BEAM EPITAXIAL GROWTH OF COMPOUND SEMICONDUCTORS AND CONTACTS

L.F. Eastman, Cornell University, Ithaca Campus, School of Engineering, Dept. of Electrical Engineering, *242 Carpenter Hall, Ithaca, New York* 14853 (DA0G8960; DAAG29-79-G-0036)

To advance the state of the art in compound semiconductor layers, Schottky barriers and Ohmic contacts for electron devices. Relevance -this research will directly support an active program at ERADCOM/ETDL to improve materials technology for very high speed integrated circuits. Close cooperation between this principal investigator and ETDL has already been established.

To use molecular beam epitaxy (MBE) to grow bulk and layered structures. Characterize and analyze grown materials for metallurgical and electrical properties in order to improve quality needed for device application.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0033, LASER-INDUCED FORCED MOTION AND *STRESS WAVES IN PLATES AND SHELLS*

H. Reismann, State University of New York, Buffalo Campus, School of Engineering & Applied Science, Dept. of Engineering, *3435 Main St., Buffalo, New York 14214* (DF042530; AFOSR-76-2943)

AF function - laser weapons technology continues to develop and Air Force flight vehicles may, in the future, be required to incorporate design-protection to avoid critical damage caused by possible radiation. Opportunity - the understanding of structural response to laser radiation will provide a basis for the development of survivability and vulnerability design improvement programs. Objective - the objective of this research is to develop sound theories which describe the time-dependent response of metallic structures to pulsed laser radiation. How work contributes - this research is part of the AFOSR program to provide a basic understanding of, and approaches to, structural behavior under exposure to those environments of concern to the USAF.

This research activity is subdivided into two phases, experimental and theoretical. As a result, the completed effort will provide a theoretical basis to predict structural response to radiation with companion data verification. Theoretically, the research will utilize basic elastic plate theory and three-dimensional elasticity. Experimentally, pulsed laser radiation will be applied to circular and rectangular clamped plates. Research will focus on describing the radiation-induced loading conditions on the plate and the resulting three-dimensional material response of the plate. Both low and high energy deposition rates will be used such that plasma formation will occur. Vacuum chamber experiments are planned during the immediate phase of the effort.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0034, LONG WAVELENGTH JEM

P. Pathak, Ohio State University, Columbus Campus, School of Engineering, Dept. of Electrical Engineering, *190 N. Oval Dr., Columbus, Ohio* 43210 (DF906190; F19628-80-C-0056)

AF function - target signatures for IFF purposes. Deficiency - the problem of noncooperative target recognition (NCTR) techniques is of first priority to the Air Force. The techniques are so inadequate that engagement is still predicated on visual identification. Objective - to determine analytically the radar cross-section at long wavelengths of a model of the jet intake region. These wavelengths are in the resonance region. The analytic results are to be compared with experimental measurements. How research contributes - at present the phenomenon of jet engine modulation (JEM) is being applied only to airborne systems using short wavelengths. The results of this research are to be applied to ground-based systems for IFF purposes. By using ground-based systems long-range identification can be achieved.

Model the jet intake as a semi-infinite, hollow, metal pipe (circular cylinder) with a simplified geometrical configuration to simulate the first compressor ring. Calculate the backscattered field by using the generalized scattering matrix technique. Compare with data from cavity models taken at frequencies from 1.0 to 12.0 GHz.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0035, RESEARCH RELATIVE TO SYNTHETIC APERTURE RADIOMETRY

H.N. Kritikos, University of Pennsylvania, School of Engineering & Applied Sciences, Dept. of Electrical Engineering & Science, *4001 Spruce, Philadelphia, Pennsylvania* 19104 (NAG 5-92)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

4.0036, A STUDY OF LOCALIZED PLASTIC DEFORMATION AS RELATED TO FATIGUE MECHANISMS

R.J. Asaro, Brown University, Graduate School, Dept. of Engineering, *University Hall, Box 1883, Providence, Rhode Island* 02912 (DF047680; AFOSR-77-3246)

AF function - certain high strength structural materials used in aerospace systems (including some aluminum and titanium alloys) are susceptible to the occurrence of strain localization. Opportunity - this phenomenon is due to the development of localized regions which are plastically unstable, and results in severe reductions in fatigue life and ductility. The process is particularly insidious since critical strain for fracture can be locally surpassed at very low average macroscopic strain, thus leading to unexpected premature failure. Objective - this research will (1) identify the experimental conditions which cause plastic deformation of homogeneous bodies to become localized into intense shear bands, (2) ascertain to what extent these bands cause material damage, crack initiation or contribute to crack growth, and (3) analyze the initiation of plastic localization both as an abrupt degradation or weakening of the material and also as an instability in the constitutive description of plastic flow. How work contributes - this fundamental study will investigate localized plastic deformation, and the role it plays in fatigue mechanisms, metal ductility, and fracture processes.

Experiments will be performed on single crystals and axisymmetric polycrystalline specimens of aluminum-copper alloys in order to precisely document the conditions of stress state, strain rate, work hardening rate, temperature and metallurgical structure which allow localization of plastic flow to occur. Subsequent studies will include 2000 and 7000 series commercial aluminum alloys.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0037, TURBULENT MIXING RESEARCH

P.T. Harsha, Arnold Research Org. Inc., *Arnold Air Force Base, Tullahoma, Tennessee* 37389 (DF420818; F40600-77-C-0003)

The objective of this experimental and analytical project is to develop reliable prediction techniques for high speed turbulent mixing processes, including those flows with exothermic chemical reactions.

Special emphasis is placed on mixing systems which are used in propulsion devices and ground testing facilities.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Arnold Engineering Development Center

4.0038, RADOME RAIN EROSION EFFECTS

R. Kinslow, State University & Community College System of Tennessee, Tennessee Technological Unviversity, School of Engineering, Dept. of Engineering Science, *P.O. Box 128A, Cookeville, Tennessee* 38501 (DA0F1358; DAAK40 77 C 0014)

The objective of this research is to develop new improved materials and coatings for missile radomes which are easier to fabricate in production and less vulnerable to field handling than the presently used slip cast fused silica.

The approach shall be to perform the following tasks: A. Analyze parametrically material erosion properties. B. Determine erosion constants of materials experimentally. C. Make microscopic analysis to determine the relative fracture resistance and crystalline structure. D. Conduct tests to determine the effects of aerodynamic heating and impact angle in terms of material properties. E. Evaluate new radome materials including laminates, composites, and coatings. F. Analyze approximately 25 conical samples eroded in sled tests. G. Compute and measure erosion rates.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Ground Equipment & Missile Structures Directorate

4.0039, GEOSYNCHRONOUS EARTH ORBIT (GEO) SIMULATION STUDY

W. Berstein, Rice University, Graduate School, *6100 Main St., Houston, Texas* 77001 (NAS 9-16166)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lyndon B. Johnson Space Center

4.0040, STUDY PLASMA INTERACTIONS IN THE AURORAL IONOSPHERE

H.R. Anderson, Rice University, Wiess School of Natural Sciences, Dept. of Space Physics & Astronomy, *6100 Main, Houston, Texas* 77001 (NAG 6-5)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Wallops Flight Center

4.0041, SPECIALIZED ENGINEERING RESEARCH EQUIPMENT FOR STRUCTURAL DYNAMICS LABORATORY

R.O. Stearman, University of Texas, Arlington Campus, School of Engineering, Dept. of Aerospace Engineering & Engineering Mechancis, *Arlington, Texas* 76019 (CME79-25776)

The equipment assists in a major upgrading of the Structural Dynamics Laboratory in the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin. This is being accomplished through the purchase of specialized research equipment in the form of a graphics terminal. The instrumentation supplements recently acquired time-series-analysis equipment and a programmable scientific calculator which is being purchased with funds from another source. The complete system provides a modal analysis system and additional system identification capabilities for use in the vibration and fluid solid interaction programs conducted in the Structural Dynamics Laboratory.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Civil & Mechanical Engineering

4.0042, EFFECTS OF WARHEAD-INDUCED DAMAGE ON THE AEROELASTIC CHARACTERISTICS OF LIFTING SURFACES

R.O. Stearman, University of Texas, Austin Campus, School of Engineering, Dept. of Aerospace Engineering, *200 W. 21st, Austin, Texas* 78712 (DF051760; AFOSR-78-3569)

AF function - this research contributes to R.O. 4.2 Aerodynamics, R.O. 4.4 Aeromechanical Elements and R.O. 6.2 Conventional Munitions. Deficiency - the ability to predict the onset of failure and highly divergent flutter instabilities caused by damaged lifting surfaces is nonexistent. The chief difficulty lies in the aerodynamic modeling and description of the problem, as there exists no aerodynamic theory to treat lifting surfaces with damages in form of surface discontinuity. Objective - to develop methodology for the aeroelastic analysis of damaged fighter aircrafts. To relate the effects of damaged lifting surfaces to changes in aeroelastic characteristics. Contribution - this research will acquire the ability to analytically predict the aerodynamic loading on and the response of damaged lifting surfaces in flow regimes of interest.

Analytical studies will first be carried out to demonstrate that several types of critical damage to aircraft will promote destructive aeroelastic instabilities. An investigation of the different available techniques for identifying the proper unsteady aerodynamic modelling of damaged lifting surfaces will then be accomplished by a combined analytical-experimental effort. This would include a study on recently developed system identification techniques as well as extensive wind tunnel testing on damaged lifting surfaces to provide insight into the development of analytical flow models useful in aeroelastic analyses.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0043, RESTORING IMAGES DEGRADED BY ATMOSPHERIC TURBULENCE

C.K. Rushforth, Utah Higher Education System, University of Utah, School of Engineering, Dept. of Electrical Engineering, *1400 E. 2nd S., Salt Lake City, Utah* 84112 (DF047250; AFOSR-77-3212)

AF function - surveillance and detection of missiles and satellites. Deficiency - degradation of images produced by atmospheric turbulence. Objective - to produce a practical procedure for achieving increased resolution in the presence of atmospheric turbulence. Contribution - increase of resolution in images degraded by atmospheric turbulence.

An improved phase-estimation algorithm based on the principle of least squares will be developed for use with the Knox-Thompson procedure to improve the quality of reconstructed astronomical images. The algorithm will be tested on simulated star photographs and compared with a previous algorithm based on a two-path integration in the image plane. The Knox-Thompson procedure will be applied to actual astronomical data obtained from Kitt Peak National Observatory. Both the two-path phase integration and the least squares algorithm will be used in the image processing.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0044, STRUCTURE OF FIELD ROTATING DISTURBANCES IN WARM PLASMA

L.T. Wolfson, Middlebury College, Graduate School, Dept. of Physics, *Middlebury, Vermont* 05753 (NAGW 54)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

4.0045, CHARGED PARTICLE BEAMS FROM A PLASMA FOCUS

G.M. Molen, Old Dominion University, School of Engineering, Dept. of Electrical Engineering, *5201 Hampton Blvd., Norfolk, Virginia* 23508 (CPE79-25563)

The research is an investigation of charged particle beams that are ejected from the pinch region of a plasma focus, particularly in the presence of applied external magnetic fields. The effect is considered of the plasma focus discharge on an auxiliary discharge between the anode and an electrode placed directly above the anode. The objectives of the research are threefold: (1) to gain a better physical understanding of the charged particle beams ejected from the plasma focus, especially with an externally applied magnetic field; (2) to test experimentally the predictions about the critical length for charged beams propagating parallel to very strong magnetic fields; and (3) to investigate the feasibility of using the the dense plasma pinch to extinguish a secondary discharge that is coincident with the dense plasma column.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Chemical & Process Engineering

4.0046, CHEMICAL MODIFICATION OF SEMICONDUCTOR SURFACES

H.O. Finklea, Virginia Polytechnic Inst. & State University, School of Arts & Sciences, Dept. of Chemistry, *Blacksburg, Virginia* 24061 (NAG 1-89)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

4.0047, DIESEL COMBUSTION ANALYSIS USING RAPID SAMPLING TECHNIQUES

G.L. Borman, University of Wisconsin, Madison Campus, School of Engineering, Dept. of Mechanical Engineering, *Madison, Wisconsin* 53706 (DA0F9238; DAAG29-78-G-0146)

To gain a better detailed understanding of diesel combustion processes, to improve the experimental methods originated under the current ARO sponsorship by superior design and construction of the in-cylinder sampling mechanism and the interpretation of the resulting data. Such data can give the basis needed to create the modeling and design methods for advanced combustion engines. Relevance - the results of this research should directly contribute to improved design of engines with higher specific output, performance, fuel economy and acceleration with minimum smoke.

Using an improved, more selective sampling device for dumping an entire cylinder charge (gaseous content in the diesel combustion chamber) at different selected crank angles, chemical analysis will be made as to the CO2, HC, CO, O2 NOX content.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

4.0048, APPLICATION OF FUNCTIONAL ANALYSIS IN FLUID MECHANICS

L. Napolitano, Universita degli Studi di Napoli, *1 Corso Umberto, Naples, Italy* (DF054480; AFOSR-79-0055)

AF function - advanced aerospace vehicles. Opportunity - to provide improved design and analysis computational tools suitable for the development and evaluation of future, high performance Air Force aerospace vehicles. Objective - to develop a new class of spline functions applicable to interpolation and/or smoothing problems for closed curves (one-dimensional spline) or closed surfaces (two-dimensional spline). How work contributes - in computational aerodynamics it is often necessary to solve interpolating problems for closed curves. Using classical splines for such cases is, in general, unsatisfactory due to problems arising at the closure point. This work has potential application in computational fluid dynamics to geometry specification and grid handling for complex geometric shapes representative of realistic flight vehicles.

The research will apply functional analysis in order to define and study various classes of closed spline functions. This will involve the definition of the spline functions as solutions of appropriate minimizati on problems in hilbert spaces. A number of optimization and tradeoff problems associated with applications of the splines will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, SEASAT PROGRAM - USE OF SEASAT DATA TO INVESTIGATE CONNECTIONS BETWEEN SEA-SURFACE TEMPERATURES AND METEOROLOGICAL FACTORS

S.A. Bowling, University of Alaska, Fairbanks Campus, Geophysical Inst., *Fairbanks, Alaska* 99701 (7-925; MO-A01-78-00-4321 MOD #2)

OBJECTIVE: The objective of this research effort is to investigate whether SEASAT and the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) sea surface temperature data can be used for the purpose of determining changes in synoptic scale sea surface temperature patterns over time periods of one to several weeks in the North Pacific basin. Time-compositing over longer time intervals and over large spatial scales will permit the study of seasonal effects on the sea surface temperature pattern change field, as well as provide a means to study the role of storm-induced changes.

APPROACH: Earth-located SMMR sea surface temperature data will be obtained over the North Pacific basin. This data set will be extended by using Nimbus-7 SMMR sea surface temperature data. The data will be manipulated point-by-point in the computer to give time rates of change of sea surface temperature, which will then be mapped. These mapped data will be compared with NOAA 5-day 700 mb maps or with SEASAT wind data from either the SEASAT-A Scatterometer System (SASS) or the SEASAT/Nimbus-7 SMMR. Map pattern correlation coefficients will be computed and used to determine the extent to which sea surface temperature changes on a weekly to monthly scale can be attributed to the large-scale features of the atmospheric general circulation.

CURRENT PROGRESS AND PLANS: Surface or sea truth data from the Gulf of Alaska SEASAT Experiment have been received and formatted. Remaining work is dependent on sensor data release.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

5.0002, INVESTIGATIONS OF THE RELATIONS OF MICROPULSATIONS TO MAGNETOSPHERIC PLASMA STRUCTURE

R.R. Heacock, University of Alaska, Fairbanks Campus, Geophysical Inst., *Fairbanks, Alaska* 99701 (ATM79-23780)

In response to the strong recommendation put forth by the Steering Committee of the International Magnetospheric Study in its 1979 Progress Report, this grant will be mainly concerned with the analysis of data accumulated during the IMS at Geophysical Institute's pulsation recording sites in Alaska, Canada, Finland, and at Macquarie Island, Australia, together with available data from IMS satellites. Problems to be studied include E-field driving functions for 3-dimensional current hydromagnetic waves and 3-D current loops, the role of the hydromagnetic waves in modulating the intensities of ELF-VLF emissions, and the propagation of Pc 1-2 waves in the F-layer horizontal waveguide.

Data will continue to be recorded, through 1980, from the College and Fort Yukon sensitive magnetometers, in f-m analog and in digital modes. The Sachs Harbour induction magnetometer will be operated at selected intervals. The Geophysical Institute induction magnetometers in Finland, Australia, and near Ottawa, Canada, will be operated at the discretion of the cooperating groups in those countries, with technical advice and some supplies furnished by this project. The overall aim is to study geomagnetic pulsations in order to understand magnetospheric dynamics.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0003, ROCKET ENGINEERING SERVICES

N. Laux, Aerojet Liquid Rocket Co., *P.O. Box 13222, Sacramento, California* 95813 (DF584170; F19628-80-C-0026)

AF function - in situ aerospace research using sounding rockets. Deficiency or opportunity - need to maintain specific pointing angles for rocket-borne payloads, and for rocket components. Objective - to provide an attitude control system (ACS), launch vehicle and analytical services, and cost-effective kick-stage rocket motors for sounding rocket probe vehicles. How development contributes - provides necessary pointing control instrumentation, kick-stage motors and field services to support scientific investigation of the earth's environment.

The contractor will provide the attitude control system, fabricate and test kick-stage motors and refurbish them after flight for reuse, provide launch support at White Sands Missile Range, N.M. and perform engineering analysis as directed. The ACS technical support personnel will perform engineering, air-bearing testing, integration with the payloads and field services for the ACS at White Sands Missile Range, N.M.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0004, SATELLITE EQUATORIAL SCINTILLATION STUDY

M.R. Paulson, U.S. Dept. of Defense, Navy, Naval Ocean Systems Center, Environmental Sciences Dept., *San Diego, California* 92152 (DN988526)

Acquire a data base which can be used to develop a statistical model of equatorial scintillation of satellite signals. Such a model could be used to predict the probability of the occurrence of significant equatorial scintillation at any given time and the extent to which satellite communications are adversely affected.

Record the signal amplitudes at Guam from the two gapfiller/MARISAT satellites at 257 and 1541 MHz for six months or more. This will provide data on scintillation activity and intensity at two frequencies and two elevation angles, 11 degrees and 51 degrees. Calculate amplitude distributions and cumulative amplitude distributions, mean and standard deviations, and fade duration distributions for several fade depths. These calculations would be made as functions of time for each of the satellites and each frequency.

SUPPORTED BY U.S. Dept. of Defense, Office of Naval Research, Earth Sciences Div.

5.0005, NORTHEAST REGIONAL OXIDANT STUDY - MICROWAVE ATMOSPHERIC REMOTE SENSING OF POLLUTION-RELATED METEOROLOGICAL PROPERTIES

B. Gary, U.S. National Aeronautics & Space Admin., Jet Propulsion Lab., *4800 Oak Grove Dr., Pasadena, California* 91103 (D0-F0124; GC05 -0737)

OBJECTIVE: The Jet Propulsion Laboratory will provide, using its MARS microwave remote sensor, measurements of (1) vertical temperature distribution in the lowest 3 km of the atmosphere; (2) moisture variations in horizontal planes adequate to determine the horizontal scale of convection; (3) precipitable water through the depth of the atmosphere; and (4) liquid water content of clouds.

APPROACH: Measurements 1-3 are to be provided at approximately 15-minute intervals during the 8-hour period beginning at 0800 LST each day. Cloud water measurements will be provided on request from the EPA field managers in Columbus, Ohio.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab.

5.0006, SUPPORT OF THE CONFERENCE ON MATHEMATICAL PROBLEMS OF THE THERMAL AND DYNAMIC STATE OF THE EARTH

L. Knopoff, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Earth & Space Sciences/

Physics, *405 Hilgard Ave., Los Angeles, California* 90024 (NASW 3416)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space & Terrestrial Applications

5.0007, GRADUATE STUDENT RESEARCHERS PROGRAM
A.H. Strahler, University of California, Santa Barbara Campus, School of Letters & Science, Dept. of Geography, *Santa Barbara, California* 93106 (NGT 05-010-800)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lyndon B. Johnson Space Center

5.0008, MEASUREMENT OF INTERACTION OF MILLIMETER WAVES WITH WATER VAPOR ON EARTH-SPACE PATHS
D.C. Hogg, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., *Boulder, Colorado* 80302 (DA0G9129)

To develop a method for remotely sensing atmospheric water vapor through better understanding of the absorption properties of water vapor at millimeter wavelengths. Relevance - the research has relevance to remote sensing of atmospheric water vapor, satellite-communication signal attenuation, and radiometric approach to the Army Millimeter Wave Program.

Absorption by water vapor will be measured using a radiometric system consisting of channels at 20.6 GHz and 31.6 GHz. Simultaneous humidity measurements will be taken by radiosonde, and absorption calculated from the water vapor profiles observed. The data will be analyzed to establish extrapolation to near millimeter wavelengths and to determine the temperature dependence of the absorption.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

5.0009, LANDSAT APPLICATIONS - TECHNICAL ASSISTANCE SERVICES
V. Klemas, University of Delaware, School of Arts & Sciences, Dept. of Geography, *Newark, Delaware* 19711 (NAS 5-26254)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

5.0010, NAVY ENVIRONMENT - THE INFLUENCE OF CONVECTING FLOWS IN THE OCEAN AND ATMOSPHERE
R.E. Krishnamurti, State University System of Florida, Florida State University, School of Arts & Sciences, Dept. of Oceanography, *205 Wildwood Dr., Tallahassee, Florida* 32306 (DN323080; N00014-75-C-0877)

Convective circulation observed in all fluids undergo transitions through several well defined regimes, leading eventually to turbulence. Flows of this nature occur in the ocean and atmosphere influencing energy balance in wind-wave interaction, turbulence generation, in subsurface thermocline inversions, and cloud pattern formation as observed by satellite. Each of these fluid dynamic phenomena must be understood for predicting the physical characteristics of ambient environments within which the Navy must operate.

Professor Krishnamurti will conduct an investigation of boundary effects on transitional convective flows and the interaction of them with superposed mean flows. Included will be studies of wind-wave interaction and surface temperature gradients which lead to convective instabilities in ocean circulation models. Stability and transition to turbulence of some flows will be examined, and the convective effects upon biological maintenance of some species will be completed. The latter study may have implications for some ASW signatures which still remain enigmas.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0011, AIR PARTICULATE SAMPLING
G.M. Hudson, State University System of Florida, University of Central Florida, School of Natural Sciences, Dept. of Physics, *P.O. Box 25000, Orlando, Florida* 32816 (NAS10-9897)

SUPPORTED BY U.S. National Aeronautics & Space Admin., John F. Kennedy Space Center

5.0012, SCIENCE SUPPORT FOR EARTH RADIATION BUDGET SATELLITE (ERBS)/STRATOSPHERIC AEROSOL AND GAS EXPERIMENT (SAGE)
D.M. Cunnold, Georgia Inst. of Technology, School of Geophysical Sciences, *Atlanta, Georgia* 30332 (NAS 1-16357)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

5.0013, SCIENCE SUPPORT FOR EARTH RADIATION BUDGET SATELLITE (ERBS)/STRATOSPHERIC AEROSOL AND GAS EXPERIMENT (SAGE)
G.W. Grams, Georgia Inst. of Technology, School of Geophysical Sciences, *Atlanta, Georgia* 30332 (NAS 1-16356)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

5.0014, REMOTE SENSING FOR STATE USE
R.A. Welch, University of Georgia, Franklin College of Arts & Sciences, Dept. of Geography, *Athens, Georgia* 30601 (NAS13-157)

SUPPORTED BY U.S. National Aeronautics & Space Admin., National Space Technology Lab.

5.0015, TROPICAL CLOUD RESEARCH
T. Takahashi, University of Hawaii System, Hilo Campus, Cloud Physics Observatory, *P.O. Box 1357, Hilo, Hawaii* 96720 (DN775082; N00014-77-C-0031)

The objective of this research is to better understand the cloud physics of the warm tropical cumulus cloud so as to be better able to define and forecast the precipitation stage of the cloud.

The research is both through modeling and field observation. Observations are made by single engine aircrat in the vicinity of Ponape in order to get purely tropical cumuli. The cloud drop spectrum and charge is observed in the upper part of the cloud. As soon as the cloud enters the rain stage there is a rapid descent to the base of the cloud to make the same observations.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0016, DEVELOPMENT OF A SUPERCONDUCTING GRAVITY GRADIOMETER
H.J. Paik, University of Maryland, College Park Campus, Graduate School, Dept. of Physics & Astronomy, *College Park, Maryland* 20742 (NAS 8-33822)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

5.0017, NAVY ENVIRONMENT - SOLAR TERRESTRIAL RELATIONSHIPS
R. Markson, Airborne Research Associates, *46 Kendal Common Rd., Weston, Massachusetts* 02193 (DN475450; N00014-74-C-0336)

The major objective of this research is to subject to experimental verification a plausible mechanism through which variable solar activity might influence tropospheric weather. If the hypothesis were to be verified, the result would contribute to important corrections of and an improvement to the naval weather forecast.

Two separate data sets will be used in the experimental verification. One is the thirty-year collection of thunderstorm data developed up to 1965 by Mae Lethbridge of the University of Pennsylvania. She has just received a grant from NSF to bring this up to date. These data will be examined for variability of

thunderstorm activity with magnetic sector crossings. The other set of data is the GOES satellite infrared pictures. Under this contract, we have developed software by which we can obtain distributions of cloudiness within latitude/longitude squares of variable size. We can also examine these data against the magnetic sector crossings.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0018, NAVY ENVIRONMENT - COOPERATIVE SUN EARTH DATA

R. Markson, Airborne Research Associates, *46 Kendal Common Rd., Weston, Massachusetts* 02193 (DN875511; N00014-78-C-0500)

As part of an international effort the objective of this research is to measure the mapping down of electric fields from the ionosphere into the troposphere. The information is necessary for an understanding of the mechanisms of solar terrestrial weather relationships for application to the naval weather forecast.

The principal investigator will measure the electric field and conductivity between 5 and 10 km altitude simultaneously with the balloon flights of Holzworth and Mozer of UCLA to be conducted at 24, 32, and 38 km at Thompson, Canada. The observations will be made during July or August 1978 depending upon the GOES satellite schedule and will also be coordinated with the European 1978 SBARMO Campaign (Scientific Balloon and Radiation Monitoring Organization).

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0019, ELECTRIC UTILITY ISSUES IN THE AREA OF FOSSIL AND ALTERNATIVE TECHNOLOGIES

M. Zussman, Energy Resources Co. Inc., *185 Alewife Brook Pkwy., Cambridge, Massachusetts* 02138 (PE; EJ-78-C-01-6394)

The objectives are to: (1) determine the impact of major coal characteristics on the direct cost of electrostatic precipitators; (2) evaluate proposed EPA NSPS for utility boilers; (3) evaluate EPA's proposed visibility regulations; and (4) study the impact of RCRA on the electric utility industry.

SUPPORTED BY U.S. Dept. of Energy, Office of Policy & Evaluation

5.0020, AIR QUALITY POLICY ANALYSIS

B.J. Goldsmith, Environmental Research & Technology Inc., *696 Virginia Rd., Concord, Massachusetts* 01742 (007414; EE-77-C-01-6036)

The purpose of the contract is to provide DOE with air quality policy analysis on a task order basis of key air quality energy/environmental issues facing the Department. Efforts have included work performed in New Source Performance Standards, Regulatory Issue Analysis on Air Issues, Visibility Impairment, etc.

SUPPORTED BY U.S. Dept. of Energy, Safeguards & Security Office, Div. of Policy Analysis

5.0021, RESEARCH IN DYNAMIC METEOROLOGY

R.S. Lindzen, Harvard University, Cambridge Campus, School of Arts & Sciences, Dept. of Applied Sciences, *Cambridge Station, Cambridge, Massachusetts* 02138 (ATM78-23330 A01)

This research will emphasize the nature of the symmetric circulation and its role in the general circulation; the stability of plane parallel flows, with special emphasis on stratified shear flow; barotropic instability and baroclinic instability; the examination of stationary waves and their possible resonance; and the generation of turbulence by internal waves. The effects of monsoons, squall lines, tides and stationary waves on baroclinic instability will also be continued.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0022, ANALYSIS OF REMOTE MEASUREMENTS OF CARBON MONOXIDE FROM CONVAIR 990 DURING MONSOON EXPERIMENT

R.E. Newell, Massachusetts Inst. of Technology, School of Science, Dept. of Meteorology, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (NAG 1-92)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

5.0023, HIGH ENERGY MAGNETIC ANALYZER

B.F. Sellers, Panametrics Inc., *221 Crescent St., Waltham, Massachusetts* 02154 (DF249100; F19628-77-C-0180)

AF function - navigation, communication and surveillance. Deficiency - inaccurate environmental specification for radiation hardness of microelectronic components in satellites. Objective - to study feasibility of using magnetic analyzers to measure 1 to 10 MeV electrons. How research contributes - direct and accurate measurement of environment will provide a data base for the design of shielding for satellite microelectronics. This will ensure suitable spacecraft lifetimes without excessive cost.

Design a flight model magnetic analyzer for the 0.1-10 MeV electrons.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0024, RAPID SCAN PARTICLE DETECTOR DATA INTERPRETATION

B.F. Sellers, Panametrics Inc., *221 Crescent St., Waltham, Massachusetts* 02154 (DF582720; F19628-79-C-0099)

AF function - communication, navigation and command. Deficiency -the data base of the high energy plasma present at synchronous orbit is inadequate to accurately describe observed charging events or to properly relate them to their ultimate cause. Objective - to operate the rapid scan spectrometer at synchronous altitudes and interpret the data returned. How research contributes - data from the rapid scan spectrometer once analyzed and interpreted will provide increased understanding of the geosynchronous plasma environment and its role in spacecraft charging.

The rapid scan particle spectrometer will be operated at the geosynchronous orbit in conjunction with the other instruments on board the SCATHA Satellite. The returned data will be analyzed and interpreted to provide definitive answers as to the plasma environment at the geosynchronous orbit as a function of geomagnetic activity, the effect of the plasma on spacecraft charging, and the response of the plasma to beam operations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0025, WIND AND TURBULENCE MEASUREMENTS AND THEORETICAL APPLICATION

I.L. Kofsky, Photometrics Inc., *Lexington, Massachusetts* 02173 (DF580500; F19628-78-C-0171)

AF function - low altitude operational satellites and ballistic nuclear weapon delivery. Deficiency - trajectory of missiles and satellites cannot be precisely calculated. Research - utilization of measured turbulent transport parameters in model atmospheres. How research contributes - permits more accurate calculations of dynamic model atmospheres. The results can be used to predict missile reentry and satellite orbit calculations.

The upper atmospheric turbulent motions will be determined from the fine detailed wind measurements (with a discrimination length of approximately 50 m) by the use of a Richardson number filter. These determined values of turbulent kinetic energy will then allow us to accurately estimate the rate of turbulent dissipation in the chemical release trail; spectral analysis permits us to determine directly the turbulent rate of dissipation, from which the turbulent diffusion coefficients may be determined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0026, CHARGING CODE VALIDATION
A.G. Rubin, U.S. Dept. of Defense, Air Force, Geophysics Lab., *L.G. Hanscom Field, Bedford, Massachusetts* 01731 (DF584700)

AF function - communications, surveillance and navigation. Deficiency - anomalous behavior of high-altitude satellites due to spacecraft charging. Objective - a 3-D SCATHA satellite computer model will be validated and verified. How research contributes - the SCATHA sheath model is required for interpretation of SCATHA data. The NASCAP code which contains the scatha model can model existing or proposed spacecraft for charging analysis, contamination studies and active control.

Computer plasma simulation codes such as the SATSS code and SCATHA/NASCAP codes and other codes to be developed or derived from existing codes will be validated and verified by exercising the codes in cases with known solutions or in simplified cases and by comparison of SCATHA flight data with code predictions. Code predictions to be validated include satellite photosheaths, charging at geosynchronous, differential charging, active control of satellite potential, prediction of detector operation and sheath structure.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0027, INSTRUMENTATION FOR ACCELEROMETER DENSITY MEASUREMENTS
J.M. Otis, Wentworth Inst. of Technology, Undergraduate School, *550 Huntington Ave., Boston, Massachusetts* 02115 (DF278900; F19628-75-C-0051)

AF function - airborne surveillance and weapons delivery. Deficiency - accurate predictions cannot be made for ephemerides for low altitude operational satellites and missile targeting because of lack of adequate density data. Research - improved accelerometers and rocket instrumentation for accurate density measurements in the 35-140 km altitude range. How research contributes - density data in this altitude range can significantly improve the accuracy of satellite ephemerides and missile targeting calculations. Objective - the object of the proposed work is to up-grade the accuracy of rocketborne techniques and instrumentation used to determine mean model values and extremes of departure about mean values under varying atmospheric conditions. A major portion of the effort under this procurement will be directed toward optimizing sensors and sub-system performance for improved density measurements over the required range. Data from rocket launches will be utilized for progressive evaluation of contract objectives and accomplishments.

Work on this contract will provide a major transition in fabrication and payload integration of new rocket hardware for 10-inch falling spheres in addition to follow-on effort on accelerometers and specialized electronic sub-systems for the standard 7-inch sphere and the hi-ball densitometer. Instrumented rocketborne payloads will be used to determine neutral upper atmospheric density and temperature in accordance with Air Force requirements. Work will include: (a) applied engineering research and development with regard to related rocketborne sub-systems, (b) fabrication, laboratory tests and calibration, (c) environmental testing to insure payload integrity, and (d) field support of rocketborne payloads launched at designated sites.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0028, ACOUSTIC PROFILING OF OCEAN CURRENTS
T.M. Joyce, Woods Hole Oceanographic Institution, *Main St., Woods Hole, Massachusetts* 02543 (NAG 1-91)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

5.0029, HALOGEN OCCULTATION EXPERIMENT
S.R. Davidson, University of Michigan, Ann Arbor Campus, Graduate School, *Rackham Bldg., Ann Arbor, Michigan* 48104 (NAG 1-93)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

5.0030, NAVY ENVIRONMENT - SOLAR TERRESTRIAL RELATIONSHIPS
A.D. Belmont, Control Data Corp., Research & Advanced Design Lab, *8100 34th Ave. S., Minneapolis, Minnesota* 55420 (DN875372; N00014-78-C-0306)

For the purpose of improving and extending the naval weather forecast, the objective of this research is to study the spatial morphology of the atmospheric response to variable solar activity to determine in what way it might affect the conventional weather forecast.

As a beginning step, studies will be made of the 27- and the 13.5-day variations in zonal wind speed on a hemispheric basis at selected levels and along selected meridians at all levels up to 30 km. These levels are proposed for study because the available data span may include solar cycles. The spatial morphology of the sun spot cycle in zonal wind speed will also be examined up to an altitude of 30 km.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0031, TROPOPAUSE CLIMATOLOGY
Unknown, Control Data Corp., *8100 34th Ave. S., Minneapolis, Minnesota* 55420 (DF583570; F19628-79-C-0098)

AF function - environmental impact assessments and laser propagation. Deficiency - current meteorological definition of tropopause height is frequently misleading regarding mid-latitude division between stratosphere air mass and troposphere air mass. This leads to a poor assessment of the stratosphere-troposphere interchange and the rate of removal of stratospheric pollutants. Objective - it is the objective of effort to review existing historical records and derive a more appropriate definition of the tropopause and to then determine the seasonal and latitudinal variations of the mass exchange across the tropopause. How research contributes - the planned measurements will lead to a new description of aerosol distribution in the lower atmosphere. These data will be used in environmental assessments and in computer models predicting optical propagation.

Analyze on a global basis a minimum of ten years of ozonesonde and radiosonde records to evaluate possible definitions of tropopause from the viewpoint of stratosphere-troposphere mass exchange. Apply the appropriate definition to the ten-year set of data to determine suitable climatology. Tables and charts are to be prepared presenting monthly means and frequency distributions as a function of year, latitude and longitude. Estimates of the stratosphere-troposphere exchange are to be determined from seasonal adjustments in the turbopause altitude.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0032, LOGISTICS SUPPORT FOR GEOLOGICAL STUDY
T. Wood, University of Minnesota, Minneapolis Campus, Graduate School, *322 Johnston Hall, Minneapolis, Minnesota* 55455 (NAS 9-16157)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lyndon B. Johnson Space Center

5.0033, TO PROVIDE REMOTE SENSING WORKSHOPS FOR STATE GOVERNMENT PERSONNEL
W.F. Miller, Mississippi State University, School of Forest Resources, Dept. of Forestry, *102 Experiment Station Bldg., Mississippi State, Mississippi* 39762 (NAS13-158)

SUPPORTED BY U.S. National Aeronautics & Space Admin., National Space Technology Lab.

5.0034, IN-CLOUD PREDICTIONS FOR SPACE SHUTTLE LAUNCHES
M.E. Glasser, Kearney State College, Graduate School, Dept. of Physics & Physical Science, *Kearney, Nebraska* 68847 (NAS 9-16162)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lyndon B. Johnson Space Center

5.0035, DEPENDENCE OF HYDROMAGNETIC ENERGY SPECTRA ON INTERPLANETARY PARAMETERS

A. Wolfe, City University of New York, Brooklyn College, Graduate School, *Bedford Ave. & Ave. H, Brooklyn, New York* 11210 (DF053380; AFOSR-78-3707)

AF function - magnetospheric disturbances can affect both ground-based and space-based communication, detection and surveillance systems. Deficiency - the relationship between solar wind parameters and the excitation of hydromagnetic waves in the magnetosphere has not been determined. Objective - to study associations and correlations between ground-based magnetic pulsations and variations in the interplanetary magnetic field and plasma. Contribution - this work will elucidate dayside hydromagnetic wave generation mechanisms and the propagation of hydromagnetic waves from the magnetopause to the earth.

Hourly power spectral analyses will be computed for the magnetic horizontal component data from Pittsburg, N.H. (l equals 3.5). The period bands 30-60 sec., 60-120 sec., and 120-240 sec. will be investigated for local daytime hours for a fifteen-day interval in 1975 when good interplanetary data coverage from the IMP J spacecraft exists. Multiple linear regression methods will be used to select the most important interplanetary parameters affecting observed ground activity. Power spectral analyses of the high time resolution interplanetary magnetic field data will be performed to study magnetic energy transfer to the ground.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

5.0036, RECOVERY AND INTERPRETATION OF PALEOCLIMATIC INFORMATION IN STABLE ISOTOPES NATURAL WATERS USING TREE-RING CELLULOSE

W.S. Broecker, Columbia University, Lamont Doherty Geological Observatory, *Palisades, New York* 10964 (ATM79-18920)

Laboratory and field studies are underway to determine the relationship between the stable isotopes hydrogen (D/HO) and Oxygen (O18/O16) in precipitation and in the annual growth of trees. These studies include an analysis of two years of carefully collected monthly global rain data by the International Atomic Energy Agency (IAEA) and detailed studies of storm tracks in the midcontinents and eastern U.S. The aim of these studies is to understand the climatological factors that affect the D/H and O18/O16 ratios in precipitation and in trees growing under these rain conditions. Modeling of the relationship between tree growth and precipitation will enable interpretation of the isotopic composition of tree rings as a paleoclimatic indicator.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0037, EVALUATION OF DIFFERENTIAL ABSORPTION LIDAR

R.J. Byer, U.S. Environmental Protection Agency, *Research Triangle Park, North Carolina* 27709 (DF336430)

To evaluate the capability of differential absorption LIDAR for remote (non-contact) sensing of environmental pollutants generated by Air Force operations. Presently available point-monitoring sensors have proven unreliable/inappropriate for determining the contribution of airfield operations to local environmental quality. A DIAL system would provide an integrated pollutant map.

An existing differential absorption LIDAR (DIAL) system will be used on targets of opportunity to determine the suitability of DIAL measurements for mapping concentrations of pollutants including hydrocarbons and sulfur dioxide. Joint funding with EPA.

SUPPORTED BY U.S. Dept. of Defense, Engineering & Services Center, Engineering & Services Lab.

5.0038, DEVELOPING SEMINARS AND SHORT COURSES IN STATE-OF-THE-ART REMOTE SENSING TECHNIQUES

Unknown, University of Oklahoma, Norman Campus, Graduate School, *660 Parrington Oval, Room 101, Norman, Oklahoma* 73069 (NAS13-156)

SUPPORTED BY U.S. National Aeronautics & Space Admin., National Space Technology Lab.

5.0039, RAVE RESEARCH ON ATMOSPHERIC VOLCANIC EMISSIONS

J.P. Friend, Drexel University, School of Science, Dept. of Chemistry, *32nd & Chestnut Sts., Philadelphia, Pennsylvania* 19104 (NAGW 84)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

5.0040, UTILIZATION OF SATELLITE DATA AND DYNAMICS IN UNDERSTANDING GLOBAL WEATHER PHENOMENA

J.H. Clark, Pennsylvania State University, University Park Campus, School of Earth & Mineral Science, Dept. of Meteorology, *116 Deike Bldg., University Park, Pennsylvania* 16802 (NAS 8-33794)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

5.0041, THE DYNAMICS OF GULF STREAM MEANDERS

D.R. Watts, University of Rhode Island, Graduate School of Oceanography, *Administration Bldg., Kingston, Rhode Island* 02881 (OCE79-21029 A01)

This project will study the dynamics of the Gulf Stream as it flows in a time-varying, meandering path after leaving the continental margin off Cape Hatteras, North Carolina. As the Stream flows into the deep water, meanders develop and grow in an envelope increasing downstream. At present both theoretical and observational inconsistencies exist regarding the current and temperature structure and the development of Gulf Stream meanders. The project involves specific tests to resolve these conflicts by: (1) analyzing existing hydrographic and temperature sections to draw new dynamical information regarding the vorticity balances in a meandering current; (2) analysis and continued collection of new data from an array of deep current meters and inverted echo sounders, instruments which are shown to be particularly well-suited for monitoring the position of the Gulf Stream; and (3) utilizing data from satellite infrared imagery that is concurrently available from existing programs. The experiment involves monitoring specific indices describing perturbations in the Gulf Stream path and structure as it leaves Cape Hatteras and testing how they are correlated with meander displacements further downstream. The field study represents the second leg of an experiment presently underway and will provide over a year's duration of data in accord with the need to observe a representative variety of stream perturbations.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Ocean Sciences

5.0042, ENHANCEMENT OF A COMPUTER MODEL DESCRIBING THE DEPOSITION OF AURORAL ELECTRON ENERGY

H.S. Porter, Furman University, Graduate School, *Poinsett Hwy., Greenville, South Carolina* 29613 (NAG 5-97)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

5.0043, RESEARCH OF ALTIMETRY DATA OVER TRENCHES AND ISLAND ARCS AND CONVECTION
G.M. Jones, Texas A & M University, College Station Campus, School of Geosciences, Dept. of Geophysics, *College Station, Texas* 77843 (NAG 5-94)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

5.0044, SEASAT PROGRAM - DETERMINATION OF A PRECISE SEASAT EPHEMERIS & OCEAN TOPOGRAPHY USING LASER & ALTIMETER MEASUREMENTS FOR MODEL IMPROVEMENTS
R.E. Schutz, University of Texas, Austin Campus, School of Engineering, Dept. of Aerospace Engineering & Engineering Mechanics, *200 W. 21st, Austin, Texas* 78712 (7-928; MO-A01-78-00-4325 MOD. #2)

OBJECTIVE: Determine a precise emphemeris by improving the geopotential and other appropriate gravitational and non-gravitational models. Produce an accurate geoid by smoothing the ocean topography obtained at different time periods.

APPROACH: To achieve the objectives, a simultaneous solution which includes a set of epoch orbital elements, a set of time-dependent atmospheric resistance parameters, a set of time-dependent solar radiation pressure parameters, a set of parameters associated with other non-gravitational forces, a truncated set of geopotential coefficients, measurement model parameters, and other parameters will be obtained. A single continuous dynamically consistent orbit of as long as possible will be used to ensure uniform sampling of the oceanic surface by the altimeter.

CURRENT PLANS: Analysis to date has concentrated on Interim Geophysical Data Records (IGDR) for the period July 28 to August 14, 1978. Reanalysis using final Geophysical Data Records (GDR) to be released during Spring 1980 will provide data for smoothing temporal changes in the ocean surface to yield an accurate geoid.

PROGRESS: Preliminary results reported at the American Geophysical Union meeting, San Francisco, December 1979.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

5.0045, TECTONIC ANALYSIS OF THE SAN LUIS BASIN SEGMENT OF THE RIO GRANDE RIFT
W.R. Muehlberger, University of Texas, Austin Campus, School of Natural Sciences, Dept. of Geological Sciences, *200 W. 21st St., Austin, Texas* 78712 (NAG 9-11)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lyndon B. Johnson Space Center

5.0046, ISIS II DATA ANALYSIS
D.J. Winningham, University of Texas, Dallas Campus, Graduate School, *Richardson, Texas* 75080 (DF582400; F19628-76-C-0005)

AF function - communications and detection. Deficiency - understanding ionospheric effects of particle precipitation in the Arctic which degrade communications in that region. Objective -investigate the effects of auroral particle precipitation, measured by the ISIS-II satellite, on the ionization balance of the high latitude ionosphere. How research contributes - this research effort is conducted to establish direct relationships between incident particle fluxes and specific features of the high latitude ionosphere which result from these particles. A description of optical and plasma properties of the ionosphere from the measurement of particle fluxes, and the behavior of these properties during substorms, will lead to more effective and adequate interpretation of the satellite measurements and enhance remote sensing capabilities. Analysis of soft particle spectrometer data from the ISIS-II satellite also provides a framework for data collected by the AFGL Airborne Ionospheric Observatory.

Assemble and interpret ISIS-II soft particle spectrometer data to specify the structure of the ionosphere in the region of the auroral oval and F-layer trough. Reduce particle data taken during selected aircraft periods for correlation with DMSP auroral photos and aircraft data. Investigate ability to use 6300 A degrees photometer data as an indicator of FOF2 in the polar trough region.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0047, MEASUREMENT OF VISIBLE AND UV EMISSIONS FROM ENERGETIC NEUTRAL ATOM PRECIPITATION DEFINITION PHASE STUDY
B.A. Tinsley, University of Texas, Dallas Campus, School of Natural Science & Mathematics, Dept. of Physics, *P.O. Box 688, Richardson, Texas* 75080 (NAS 8-33827)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

5.0048, DEVELOPMENT, INTEGRATION, MISSION SUPPORT AND DATA ANALYSIS OF THE IMAGING SPECTROMETRIC OBSERVATORY EXPERIMENT FOR SPACELAB MISSION I
M.R. Torr, Utah Higher Education System, University of Utah, Graduate School, *310 Park Bldg., Salt Lake City, Utah* 84112 (NAS 8-33992)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

5.0049, AN EXPERIMENTAL INVESTIGATION OF THE ANGULAR SCATTERING AND BACKSCATTERING BEHAVIOR OF THE SIMULATED CLOUDS OF THE OUTER PLANETS
K. Sassen, Utah Higher Education System, University of Utah, School of Mines & Mineral Industry, Dept. of Meteorology, *1400 E. 2nd S., Salt Lake City, Utah* 84112 (NAGW 82)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

5.0050, HALOGEN OCCULTATION EXPERIMENT (HALOE) SCIENCE INVESTIGATION
H.E. Schone, College of William & Mary, Williamsburg College, School of Arts & Sciences, Dept. of Physics, *Ewell Hall, Williamsburg, Virginia* 23185 (NCC 1-43)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

5.0051, LOCAL EFFECTS OF PARTLY CLOUDY SKIES ON SOLAR AND EMITTED RADIATION
D.D. Venable, Hampton Inst., Graduate School, *Hampton, Virginia* 23368 (NAG 1-87)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

5.0052, APPLICABILITY OF MASSIVE PARALLEL PROCESSOR TO THE UTILIZATION OF ECOLOGICAL AND LAND-USE MODELS
R. Huralick, Virginia Polytechnic Inst. & State University, Graduate School, *Blacksburg, Virginia* 24061 (NAS 5-26276)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

5.0053, PREDICTABILITY AND PREDICTION IN A SIMPLE MODEL ATMOSPHERE
G. Holloway, University of Washington, Graduate School, *Seattle, Washington* 98105 (ATM79-10604)

Theoretical predictability of the atmosphere, assuming a perfect dynamical model, is limited by the time over which uncertainty in initial data is transferred by nonlinear processes into all predicted scales of motion. Actual prediction skill is further limited by inadequacies in the formulation of physical-numerical models. This research will consider both questions, seeking (1) to refine theoretical estimates of ideal predictability, and (2) to identify a possible source of loss in prediction skill. The predictability study will follow the turbulence closure theory ap-

proach, here extended to include effects of atmospheric planetary wave propagation. Questions of prediction skill will focus on possible effects of wave-wave interaction on phase and group speeds of atmospheric planetary waves. A third area of investigation will concern possible specific configurations of an atmosphere which might be predictable over an anomalously long time in the sense of persistent finite amplitude solutions of model equations.

This research addresses one of the primary objectives of the Global Atmospheric Research Program (GARP) which is to extend the useful range of weather forecasting.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0054, GEOLOGIC REMOTE SENSING

J.B. Adams, University of Washington, School of Arts & Sciences, Dept. of Geological Sciences, *Seattle, Washington* 98105 (NAGW 85)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space & Terrestrial Applications

5.0055, SATELLITE OBJECTIVE FORECASTING

R.S. Hawkins, University of Wisconsin, Madison Campus, School of Letters & Science, Dept. of Meteorology, *500 Lincoln Dr., Madison, Wisconsin* 53706 (DF581920; F19628-78-C-0137)

AF function - weather observing, analysis and forecasting for military operations. Deficiency - lack of information to meet military weather support requirements. Objective - to develop automated techniques which utilize meteorological satellite data and, where necessary, conventional data in the objective specification and forecasting of mesoscale weather features. How development contributes -successful development of these techniques will allow automated forecasts of weather conditions at many locations satisfying AWS requirements specified in AWS TN 3-76.

Objective techniques will be developed using both satellite and conventional data. Use will be made of interactive data display systems to assist in identifying features of the satellite imagery and conventional data analyses that have potential as predictors. Tests will be made to evaluate how well forecasts with satellite data alone compare with those using conventional data as well.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0056, NAVY ENVIRONMENT - SUBMARINE AND AIRCRAFT PROFILING OF ARCTIC SEA ICE

R.W. Burling, University of British Columbia, Inst. of Oceanography, *2075 Wesbrook Pl., Vancouver, British Columbia, Canada* V6T 1W5 (DN675325; N00014-78-G-0003)

ASW/USW in the Arctic require definition of the environment in order to operate. For example, acoustic propagation transmission loss has been found to be directly related to under-ice roughness. The scientific objectives are to study the effects of wave-ice interaction and wave-induced fracture in the marginal ice zones of the east Greenland current and southern Baffin Bay. Applications of this research include ambient noise relationships to wave interaction with the edge of the pack and wave break-up of ice to ice thickness/distribution models.

Two field experiments will be carried out. One in September, 1979 will be based out of Mestersvig and one in March/April out of Holsteinberg. Danish and Canadian remote sensing planes will provide additional surface measurement of ice type and wave attenuation within the ice pack.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0057, FALL-OUT WINDS FROM SATELLITE RADIANCE OBSERVATIONS

G. Ohring, Tel Aviv University, Dept. of Geophysics & Planatary, *155 Herzl St., Tel Aviv, Israel* (DA0D9338; DAERO 77 G0051)

The major purpose of the proposed research program is to develop and test techniques for inferring effective fall-out winds directly from mix of satellite radiance and conventional (radiosonde) observations.

The proposed technique should enable a simple, quick, direct transformation of the satellite radiance observations to effective fall-out wind. The research will test and validate the technique on the sets of satellite and conventional (radiosonde) data available for White Sands Missile Range before testing the technique on field operational satellite and conventional observations.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Research & Standardization Group

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, BIOMEDICAL APPLICATION & HEALTH HAZARD ASSESSMENT OF OXYGEN ENRICHMENT BREATHING SYSTEMS

R.N. Armstrong, U.S. Dept. of Defense, Army, Medical Research & Development Command, Field Research & Biomedical Applications Div., *Fort Rucker, Alabama* 36362 (DA0G0169)

To identify, assess, and prevent unnecessary health hazards associated with the flight environment and to obtain a biomedical data base on the human function associated with the use of aircraft oxygen enrichment breathing systems in the flight environment. To provide the Army data, information, recommendations and criteria to aid in the development and deployment of life support systems to alleviate identified health hazards.

The approach will consist of a biomedical evaluation of state-of-the-art oxygen enrichment breathing systems during aircraft ground and flight conditions. The evaluation will include the sampling of the environmental air input to the system as well as the system output, enriched air. The samples will be analyzed to determine the systems' ability to effectively filter contaminants known to exist in the operational environment. Physiological data, heart rate, oxygen tension and respiratory functions as well as system parameters, oxygen concentration, flow rates, temperatures and pressures will be collected during ground operations and aircraft flight at altitude to assess the ability of the system to provide aviators the required oxygen concentration and purity during various flight profiles. The data collected will be evaluated with respect to biomedical, safety, and man/machine limitations.

SUPPORTED BY U.S. Dept. of Defense, Medical Research & Development Command, Aeromedical Research Lab.

6.0002, ASUPT NIGHT SCENE EVALUATION

E.L. Martin, U.S. Dept. of Defense, Air Force, Human Resources Lab., *Williams Air Force Base, Chandler, Arizona* 85224 (DF222070)

To evaluate the extent to which simulator training using ASUPT reduced field of view night scene transfers to T-37 aircraft daytime training.

A data base on trials to proficiency in T-37 aircraft training on selected maneuvers has been developed in work unit 1123-01-14 under conditions of no ASUPT training and using the full ASUPT day visual scene. The proposed project will extend these data by providing training on selected maneuvers using the ASUPT night scene with a reduced field of view. A sample of UPT trainees will be trained using the same syllabus developed for the earlier study but restricting the ASUPT visual to a night scene and to a 28 degrees x 44 degrees FOV. Trials to

criteria on each maneuver will be recorded in the aircraft and these data compared to those compiled in the earlier study.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0003, AFHRL/NTEC ASPT/AWAVS COOPERATIVE RESEARCH - CARRIER LANDING

R.R. Woodruff, U.S. Dept. of Defense, Air Force, Human Resources Lab., *Williams Air Force Base, Chandler, Arizona* 85224 (DF224190)

To determine pilots' ability to perform carrier landings using a wide field of view following training under either wide field of view or narrow field of view conditions.

A carrier modeled for use with the ANAVS will be displayed in the ASPT. Three groups of T-38 IPs will be trained in carrier landings. Group A will fly a circling approach and landing under wide FOV conditions, Group B will fly a circling approach and landing under narrow FOV conditions. Group C will fly a straight-in approach under narrow FOV conditions. After completing these training trials, the IPs in Groups B and C will fly circling approaches and landings under wide FOV conditions. The IPs in Group B will be provided audio or visual stimuli designed to cue them as to when they should begin their turn to final approach. The number of trials required to reach a criterion level of performance will be recorded and analyzed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0004, ABIOTIC SYNTHESIS - STUDIES OF POTENTIAL PRIMEVAL ATMOSPHERES AND THE DEVELOPMENT OF BIOLOGICALLY SIGNIFICANT MOLECULES

A.C. Ling, California State University & Colleges, San Jose State University, School of Science, Dept. of Chemistry, *Washington Sq., San Jose, California* 95192 (NCA 2-675008)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

6.0005, AIRCRAFT OXYGEN GENERATION BY MEMBRANE PERMEATION

D. Johnson, Garrett Corp., *2525 W. 190th St., Torrance, California* 90509 (DF324890; F33615-79-C-0609)

This effort is to design, construct and test a staged gas permeation system to demonstrate the technical feasibility of producing aviator's breathing oxygen from aircraft engine bleed air.

The use of membrane gas permeators offers an alternative technology for on-board generation of breathing oxygen, which may offer the advantage of 100 percent contaminant-free oxygen coupled with a low aircraft power penalty. Various types of membranes will be investigated for oxygen permeation. Based on this data, a model system is to be constructed capable of delivering 20 liters/minute of 90 percent oxygen and to determine the effect of operating parameters as feed pressure, temperature, and flow on oxygen concentrations. In addition, recommendations are to be included for up-grading the oxygen system to a prototype configuration which must provide 95 to 99 percent oxygen at flow rates up to 40 liters/minute.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0006, STUDY, COMPUTER-BASED LANDING SIGNAL OFFICER CARRIER AIRCRAFT RECOVERY MODEL

G. Borden, Human Performance Research Inc., 616 Carlo Dr., Goleta, California 93017 (DN894013; N61339-77-C-0110)

In support of development of a trainer for landing signal officers (LSO), a study is required to expand a laboratory-developed preliminary model of ideal LSO 'waving' behavior to include precautionary and advisory calls. The model will be used to judge performance of student lsos during training.

Initial model bases power and waveoff calls (EMCON model) on three approach parameters. Expanding number of monitored parameters and degree of approach segmentation will allow all NATOPS calls to be generated.

SUPPORTED BY U.S. Dept. of Defense, Naval Training Equipment Center, Human Factors Lab.

6.0007, METABOLIC RATE AND THYROID FUNCTION IN THE MONKEY - SUBJECT OF THE COSMOS 81 MISSION

N. Pace, University of California, Berkeley Campus, School of Letters & Science, Dept. of Physiology Anatomy, *Berkeley, California* 94720 (NAS 2-10658)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

6.0008, ISOLATION OF CIRCULATORY INFLUENCE IN HIGH STANDARD GRAVITY

R.E. Burger, University of California, Davis Campus, School of Agriculture & Environmental Sciences, Dept. of Avian Science, *Davis, California* 95616 (DF049870; AFOSR-77-3430)

AF function - the Air Force operational environment involves exposure to a wide variety of mechanical forces including high sustained acceleration (HSG). It has been recognized that cardiovascular responses can be encountered which may be particularly important in determining performance capabilities in aircrew members. Deficiency - exposure to high sustained acceleration (HSG) produces myocardial pathologies in small mammals. Both subendocardial hemorrhages and cardiac myopathies have been observed in swine subjected to acceleration stress. Recently, similar pathologies have been discovered in avian species, suggesting an interspecies response and providing an excellent model for study. The possibility exists that man subjected to extreme acceleration stresses, as in the new maneuverable fighter planes, may be developing similar cardiac myopathies. The cause of these damages deserves investigation. Objective - this study will evaluate the component of arterial hypoxia in susceptibility to HSG, using domestic fowl as subjects. One can artificially maintain oxygenation via a catheter inserted into the air sac, a procedure that is not compatible with the thoracic respiratory system of mammals. This procedure removes ventilatory impairment as a factor determining response to HSG. How research contributes - this research will complement ongoing exploratory work at USAFSAM dealing with the effects of HSG on the cardiovascular system, with emphasis on 'g' induced cardiomyopathy. It directly supports subarea 1.6, 'Habitable Crew Environments in Air Force Operations.'

Estimate oxygen metabolism as a measure of circulatory impairment and potential myocardial susceptibility to HSG, calculate mixed venous oxygen concentration to aid in assessing perfusion abnormalities, determine RQ which will indicate the presence of absence ventilation perfusion inequalities, and estimate the contribution of arterial hypoxia on myocardial pathology.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0009, AN EVALUATION OF MALE AND FEMALE ANXIETY DURING SERE TRAINING

D.C. Gillman, U.S. Dept. of Defense, Air Force, Air Force Academy, Behavioral Science & Leadership Dept., *Colorado Springs, Colorado* 80840 (DF282270)

AF function - technology base. Deficiency - adequate information on the response of AF cadets to stress-inducing situations at the USAF Academy is not available. Objective - the purpose of this study is to examine several aspects of anxiety and stress in second-year cadets participating in survival, evasion, resistance, and escape (SERE) training. How work contributes - the results of this study will make it possible to determine the levels of anxiety present in male and female cadets and to compare these anxiety levels with national collegiate norms. Further, it will determine how stable trait anxiety is, how much anxiety, stress, depression, and fatigue SERE training creates in men and women, and how stressful the SERE experience is compared to a normal college environment.

This effort is a continuation of work begun during the summer of 1977. Approximately 450 cadets from the class of

1980 were administered a questionnaire comprised of the following instruments: the Eight-State Questionnaire, Institute of Personality and Ability Testing (IPAT), Champaign, Illinois, the Anxiety Scale Questionnaire, IPAT, the Stressful Situations Questionnaire, Hodges and Felling, 1976, and specially constructed items dealing specifically with SERE training. These same instruments, with slight modifications, will be administered to the class of 1981 before and after SERE training during the summer of 1978. This pre-test/post-test design will detect any change in anxiety levels caused by SERE, and will yield valuable information about male versus female response to physically and mentally stressful experiences.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Frank J. Seiler Research Lab.

6.0010, HUMAN OPERATOR CONTROL STRATEGY MODEL

J.L. Birchfield, Georgia Inst. of Technology, Engineering Experiment Station, *225 North Ave. N.W., Atlanta, Georgia* 30332 (DF228160; F33615-77-C-0042)

Develop and validate a model of human operator control strategy on perceptual/motor tasks such as flying and investigate relationships between control strategy and cue utilization, learning, and changes in task variables.

Identify human operator characteristics that ought to be considered, develop an operational definition of control strategy, conceptualize and implement a model based on a defendable theory-of-control strategy development and learning, and conduct extensive validation tests. Milestones - contract award, 1 Apr 1977, theory development, 1 Oct 1977, model design, 1 Dec 1977, model testing, 1 Oct 1978, first TR, 30 Apr 1979, validation, Dec 1979, second TR, May 1980, optional demonstration, Oct 1980, final TR, Mar 1981.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0011, VENTILATORY CONTROL MECHANISMS AT HIGH ALTITUDE (22)

J.T. Maher, U.S. Dept. of Defense, Army, Medical Research & Development Command, Research Inst. of Environmental Medicine, *Natick, Massachusetts* 01760 (DA0B6132)

The physiologic processes which control the ventilation of man at high altitude are not fully understood. The objective of this work unit is to gain new knowledge of ventilatory control, with emphasis on adaptations within the control system during exposure to chronic hypoxemia, as experienced during sojourns at high terrestrial altitudes. A thorough understanding of this aspect of altitude physiology is essential in defining new approaches for enhancing the adaptation of the soldier to high terrestrial elevations.

An integrated program is under way to analyze contributions of both the carotid body and medullary chemoreceptors to the ventilatory adaptations of man to hypocapnic hypoxia, including interactions between the two chemoreceptors. Studies are also being carried out to determine contributions of the peripheral and central chemoreceptors to the increase in ventilation during muscular exercise exceeding the anaerobic threshold, as would be seen frequently at high altitude.

SUPPORTED BY U.S. Dept. of Defense, Medical Research & Development Command, Research Inst. of Environmental Medicine

6.0012, CENTER OF EXCELLENCE FOR BIOMEDICAL APPLICATION OF ION THRUSTER TECHNOLOGY

D.F. Gibbons, Case Western Reserve University, School of Medicine, Dept. of Biomedical Engineering, *2109 Adelbert Rd., Cleveland, Ohio* 44106 (NAS 3-22443)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

6.0013, BIOMECHANICS OF COCKPIT EVALUATION

W. Hovey, University of Dayton, Research Inst., *300 College Park Ave., Dayton, Ohio* 45469 (DF317180; F33615-78-C-0507)

To improve USAF's capability to provide human engineering support to the design and evaluation of crewstations by automating the complex operator/machine interaction by means of a three-dimensional interactive graphics computer model. To automate the handling of body-size variability data to improve the utility of these data to guide the design of AF systems and equipment. To provide computer techniques for evaluating the effects of flight clothing on operator's interaction with the crewstation. To provide computer methods for sizing and design of personal-protective equipment.

The utility of the COMBIMAN (computerized biomechanical man-model) will be enhanced by the expansion of data bases for clothing/personal-protective equipment and aircraft cockpits. Techniques for automated reach-task analysis will be improved. A technique for the elimination of hidden lines on the display will be developed. AMRL's force testing devices will be used to obtain male and female strength data for the design and placement of aircraft controls.

SUPPORTED BY U.S. Dept. of Defense, Aerospace Medical Research Lab., Human Engineering Div.

6.0014, THE IDENTIFICATION OF PSYCHOPHYSIOLOGIC CORRELATES OF COGNITIVE PROCESSING

F.J. Bremner, Trinity University, School of Arts & Sciences, Dept. of Psychology, *715 Stadium Dr., San Antonio, Texas* 78212 (DF055850; F49620-79-C-0139)

AF function - a requirement exists for monitoring the brain activity of the pilot, evaluating his workload, his decision making ability, his workload processing ability, and his capability to respond to the system interface. Deficiency - the relationship of cortical events to the cognitive/information processing/decision making activities of mental processes has not been well documented. Also, it is not known how workload affects cortical events nor how fatigue affects electrophysiological correlates of cognitive processing. Objective - the research will (1) demonstrate the feasibility of using electrophysiological variables to assess the level of cognitive processing occurring at any given time in aircraft pilots, and (2) determine if variables previously shown to be potent in decreasing pilot effectiveness will also affect the electrophysiological variables associated with cognitive processing. How research contributes - the proposed research represents an initial attempt to explore and identify selected psychophysiologic correlates (electroencephalogram, visual evoked response, heart rate, and heart rate variance) of cognitive processing. In addition, it will be possible to evaluate the cortical effects of fatigue on these correlates.

Four subject groups will be selected. Group one will perform a high-cognitive processing task. Group two will perform a low-workload cognitive processing task. Group three will perform the high workload task plus be subjected to a situational state representative of cognitive fatigue. Group four will perform a non-cognitive processing control task. The dependent variables will be (1) electrophysiological, and (2) motor responses. The inherent EEG variables will be analyzed by means of a fast Fourier transform. The dependent variables will be submitted to a factor analysis. Results of the statistical treatments will identify predictor variables for future studies designed to expand current knowledge and use of brain monitoring technology in the context of the man/machine interface.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0015, AIR FORCE VALIDATION OF ASVAB FORMS 6 AND 7

J.J. Mathews, U.S. Dept. of Defense, Air Force, Human Resources Lab., *Brooks Air Force Base, San Antonio, Texas* 78235 (DF233130)

To validate operational asvab subtests and composites against Air Force technical training performance criteria.

Current ASVAB tests will be correlated with technical training criteria. Some analyses will involve data which has been collected on 9,000 airmen experimentally administered ASVAB-7A. Possible sex and racial interactions in selector composite based prediction will also be investigated. In instances where feasible, new composites will be formed for appropriate technical courses. Operational ASVAB test data col-

lected at field stations (data will be obtained from MARDAC tapes) will also be validated, and comparisons will be made between experimentally and operationally administered test results. Milestones -- field tested samples selected - 1 May 77 to 1 Jul 77, operational test analyses - 1 Jul 77 to 1 Nov 77, interim TR preparation - 1 Nov 77 to 1 Mar 78, ASVAB7A samples selected - 1 Jun 77 to 1 Sep 77, ASVAB7A analyses - 1 Sep 77 to 1 Feb 78, administration comparison - 1 Mar 78 to 1 Sep 78, final TR preparation - 1 Oct 78 to 1 Mar 79.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0016, IMPROVED PRODUCTIVITY THROUGH USE OF INTRINSIC REWARDS AND FEEDBACK TECHNIQUES

R.D. Pritchard, University of Houston, School of Social Sciences, Dept. of Psychology, *3801 Cullen Blvd., Houston, Texas* 77004 (DF233260; F33615-78-C-0025)

The purpose of this research is to develop guidelines for implementing a set of effective feedback and goal-setting techniques in Air Force operational environments. These techniques concentrate on increasing the airman's motivation to perform through intrinsic motivation procedures applied at the level of the first-line supervisor. The guidelines developed will require a minimal amount of outside intervention into these organizations.

The determinants of feedback have been identified and narrowed to a number of optimal techniques that can be introduced into Air Force organizations. Three different types of organizations will be selected in which to field test these techniques. Productivity criteria will be located/generated for these organizations. After the techniques have been introduced, their impact on productivity and job satisfaction will be assessed. During the intervention phase, goal-setting techniques will be introduced in order to determine any additional benefits that might be incurred. A follow-up phase will investigate the long range effects of the intervention. The milestones for this work unit are: (1) site selection, 1 Jun 78-31 Jul 78, (2) design interventions, 1 Apr 78-31 Dec 78, (3) institute interventions, 1 Jan 79-31 Aug 79, (4) analyze data, 1 Sep 79-31 Oct 79, (5) write technical report, 1 Nov 79-31 Dec 79, (6) review and revise technical report, 1 Jan 80-29 Feb 80, (7) follow-up evaluation, 1 Jan 80-30 Apr 80, (8) submit final report, 30 Apr 80.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0017, ADVANCED HELMET-MOUNTED SIGHT (AHMS)

A.R. Deruyck, Polhemus Navigation Sciences Inc., *Burlington, Vermont* (DF322380; F33615-77-C-0513)

To design, develop and fabricate a laboratory grade advanced helmet-mounted sight (AHMS) system that will provide six degrees of freedom position information of a subject's helmet in suitable output format necessary for integrating it into the visually coupled airborne systems simulator (VCASS) program. Two additional objectives of this program are to develop a suitable integration of the AHMS system with state-of-the-art wide field-of-view (FOV) side-mounted helmet mounted display (HMD) optics and cathode ray tubes (CRT) and to develop a long range multiplexed AHMS system which will allow resolution of helmet position and attitudes at distances far greater than those required in high performance aircraft.

This effort will be divided into four phases: (1) conceptual design phase, (2) detailed design and fabrication phase, (3) test phase, and (4) engineering support phase. Each of these phases shall concentrate on four major areas of development- (1) primary AHMS hardware and programming, (2) hardware and programming for the long-distance multiplexed AHMS (LAHMS), (3) hardware and programming necessary to provide integrated HMD/AHMS (HAHMS), and (4) system electronics processing and control circuitry. Each phase has predetermined goals which must be met in each of these four areas before work can proceed into the next phase. Finally, sufficiently severe testing is performed in characteristic environments to assure that VCASS requirements are met and that system viability for a follow-on airborne qualified system is achieved.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, DATA MANAGEMENT AND LANGUAGE ENHANCEMENT FOR GENERALIZED SET THEORY COMPUTER

G.T. Finley, University of the District of Columbia, Undergraduate School, *4100 Connecticut Ave. N.W., Van Ness Campus, Washington, District of Columbia* 20008 (NAG 5-91)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

7.0002, PIPLINE PROCESSOR DESIGN FOR COMMUNICATION SYSTEMS

G.K. Maki, University of Idaho, School of Engineering, Dept. of Electrical Engineering, *Moscow, Idaho* 83843 (NAG 5-93)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

7.0003, IMPROVING COMMUNICATIONS BETWEEN HUMANS AND COMPUTER-DIRECTED AUTOMATIC SYSTEMS

C.J. Rieger, University of Maryland, College Park Campus, Graduate School, Dept. of Computer Science, *College Park, Maryland* 20742 (NAG 5-99)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

7.0004, NONLINEAR PROBLEMS OF CONTINUUM MECHANICS AND MATHEMATICAL PHYSICS

M.S. Berger, Inst. for Advanced Study, *Princeton, New Jersey* 08540 (DF051360; AFOSR-78-3558)

AF function - aerospace vehicle design techniques. Deficiency -weight reduction and other optimization leads to large structural distortions which are not well understood. Objective - to improve the self-consistency and rigor of existing mathematical techniques and create new ones. How work contributes - through more dependable mathematical models.

Nonlinear problems in continuum mechanics and mathematical physics exhibit unique properties such as solitons, or bifurcation which are important to future engineering design. Techniques to be applied include functional analysis, calculus of variations in the large, and a study of the singularities of mappings. Applications may be expected in areas including the structural stability and plasticity of thin shells, parametric instability and resonance for Hamiltonian autonomous systems, soliton perturbation and superconductivity.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0005, A CHRONOLOGICAL ANNOTATED BIBLIOGRAPHY ON ORDER STATISTICS

H.L. Harter, Wright State University, School of Science & Engineering, Dept. of Mathematics, *Dayton, Ohio* 45431 (DN075036; N00014-80-C-0067)

Extreme values play an important role in the performance of naval vehicles, including, for example, gust loads on aircraft or ships and weakest components in complex systems. It is highly desirable to have a systematic, orderly study of order statistics, the branch of statistics concerned with extreme values.

The contractor will prepare a chronological annotated bibliography on order statistics.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

7.0006, MATHEMATICAL MODELING AND SIMULATION OF THE ADVANCED SYNTHETIC APERTURE RADAR (ASAR) PROJECT
C.R. Griffin, University of Texas, Austin Campus, School of Engineering, *200 W. 21st, Austin, Texas* 78712 (NAS 9-16171)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lyndon B. Johnson Space Center

7.0007, DOCUMENTATION AND RESEARCH SUPPORT IN THE USE OF MACSYMA
S.J. DeLoatch, Norfolk State College, Undergraduate School, Dept. of Mathematics, *2401 Corprew Ave., Norfolk, Virginia* 23504 (NAS 1-16361)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

7.0008, MANAGEMENT TOOLS CASE STUDY
J. Brown, Boeing Computer Services Inc., *P.O. Box 24346, Seattle, Washington* 98124 (DF729260; F30602-78-C-0044)

The objective is to examine in depth a large ongoing development program with advanced management tools and procedures carefully selected to complement advanced software production technology.

The approach of this effort is to examine the NASA IPAD (integrated program for aerospace vehicle design) documentation and to assess its potential for use in validating management models to be developed in the subsequent year. The IPAD program under contract to BCS is the only known program appropriately instrumented to yield data which appears useful to validate several planning and assessment models. The ultimate end item is checklists and SOPs for planning, reviewing, and acting on software development products.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, MATERIAL SUPPORT TECHNOLOGY - ELECTRONIC PROPERTIES OF HETEROJUNCTIONS
J.O. McCaldin, California Inst. of Technology, Graduate School, Dept. of Applied Physics, *1201 E. California Blvd., Pasadena, California* 91109 (DN675685; N00014-76-C-1068)

The performance and reliability of electron and optical devices for future Navy electronic systems requires better understanding and control of the properties at the interfaces between semiconductor materials. The structural and electronic properties of these interfaces or heterojunctions need further study to determine the factors which influence the fabrication of reliable devices and the analysis of possible classes of electron devices.

Theoretical tight binding calculations will be used to explore the electronic nature of semiconductor heterojunctions and superlattices. For heterojunctions, the relation between interface states and bulk states will be clarified. The mercury chalcogenide-cadmium chalcogenide heterojunction will be investigated in terms of a lattice matched Schottky barrier due to the semimetal nature of the mercury systems. The modified structure will be investigated with regard to barrier formation and interface states. The experimental program will continue to investigate barrier heights for gold on ternary compound semiconductors with a single anion component. Highly electronegative contacts to semiconductors will be studied in the mercury sulfide-cadmium sulfide system.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0002, ION PHOTOFRAGMENT SPECTROSCOPY - POTENTIAL SURFACES OF MOLECULAR IONS
J.T. Moseley, S R I International, *333 Ravenswood Ave., Menlo Park, California* 94025 (DF043690; F44620-76-C-0095)

AF function - Air Force operations in reconnaissance, communications, detection and discrimination require understanding of complex atomic, molecular and ionic phenomena that occur in the natural and disturbed atmosphere. Deficiency - there is a lack of sufficient, quality information on fundamental processes that occur in the atmosphere that affect electron densities, which hinder propagation of electromagnetic signals in the presence of perturbed atmosphere backgrounds. Objective - investigate the energy and angular distributions of photofragment ions from parent molecular ions important in the atmosphere and interpret experimental results in terms of the parent ion molecular potentials and structural properties. Examine and interpret photodetachment cross sections if important in these ions. How work contributes - provides a measure of ion and electron densities in the normal and disturbed atmosphere which affect communication signals. Also important in the development of high energy lasers.

Use of laser and a fast ion beam apparatus termed the coaxial-beam photofragment spectrometer to produce photofragmentation of polyatomic atmospheric ions and other ions of interest. Determine photofragment energy and angular distributions to establish the structural properties of the ions. If important, interpret results of photodetachment cross section investigations in terms of vertical detachment energies and electron affinities.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0003, RESEARCH IN SOLAR PLASMA THEORY
P.A. Sturrock, Stanford University, School of Humanities & Sciences, Dept. of Applied Physics, *Stanford, California* 94305 (NAGW 92)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

8.0004, CROSSED MOLECULAR BEAMS
Y.T. Lee, University of California, Berkeley Campus, Lawrence Berkeley Lab., *Berkeley, California* 94720 (60)

Investigations are underway of the dynamics of elementary atomic and molecular processes and the energetics and the structure of exotic radicals, ions, and ion clusters using the crossed molecular beam method. Information on mechanism and dynamics of chemical reactions is obtained from the direct identification and measurements of velocity and angular distributions of product molecules from single collisions. Significant advancement was made recently in combustion-related elementary reactions. In the reaction of oxygen atoms with benzene, the importance of a substitution channel was elucidated for the first time. Successful crossed molecular beam studies on O(/sup 1/D) plus H2, D2 as well as O(/sup 1/D) plus CH4 were also carried out. The significant and exciting resonance phenomenon in chemical reactions which was predicted in quantum mechanical calculations was observed in the angular distribution of HF(v equals 2) formed in the F plus H2 reaction. By use of the autoionization process for the preparation of vibrational state-selected H2 ion, the effect of translational and vibrational energy in H2 ion plus D2 yields HD2 ion plus H was studied in great detail. By using the vibrational predissociation process, the infrared spectrum of isolated water molecule clusters was obtained in a molecular beam.

SUPPORTED BY U.S. Dept. of Energy, Office of Energy Research

8.0005, FINE PARTICULATE MONITORING IN THE WESTERN ENERGY RESOURCE DEVELOPMENT AREA
T. Cahill, University of California, Davis Campus, School of Letters & Science, Dept. of Physics, *Davis, California* 95616 (R806459-01; JC2Q -83)

OBJECTIVE: Establish a baseline of air ambient fine particulate data in the Western Energy Resource Development Area.

APPROACH: A forty-station fine particulate sampling network will be deployed over the states of Arizona, New Mexico, Colorado, Utah, Wyoming, North Dakota, Montana, and South Dakota. The mass and elemental composition of aerosols in two size ranges (less than 2.5 micron, less than 15 micron) will be determined on the twice-weekly samples at each station. Correlations will be developed with meteorological data and other air quality measurements (e.g., visibility).

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Monitoring & Systems Lab.

8.0006, RESEARCH IN SOLAR PLASMA THEORY
G. Van Hoven, University of California, Irvine Campus, School of Physical Sciences, Dept. of Physics, *Irvine, California* 92664 (NAGW 93)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

8.0007, EXPERIMENTAL STUDIES OF NORMAL METAL INTERACTIONS UTILIZING PROXIMITY EFFECT TUNNELING
P.M. Chaikin, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Physics, *405 Hilgard Ave., Los Angeles, California* 90024 (DMR78-12000)

This is a continuation of work sponsored under DMR-7608899. An experimental study will be made of normal metal interactions by means of proximity effect tunneling. For a variety of normal metals proximity effect tunneling will be used to obtain the phonon density of states, the electron-phonon interaction, the Fermi velocity, and energy dependent lifetimes in the normal metal. The spin glass transition, the effect of magnetic impurities in normal metals and non-equilibrium superconductivity in the proximity effect configuration will be studied. This work is important for understanding non-equilibrium super conductivity and the proximity effect in normal metals.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0008, COMMUNICATIONS AURORAL CURRENT MODULATION THROUGH RESONANT ABSORPTION IN THE AURORAL IONOSPHERE
G.J. Morales, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Physics, *405 Hilgard Ave., Los Angeles, California* 90024 (DN075276; N00014-80-C-0373)

Theoretical research will be conducted on nonlinear processes associated with resonant heating of auroral plasmas in order to provide the basis for theoretical calculations of low frequency electromagnetic wave generation for naval communications by modulation of auroral currents or nonlinear or resonant mixing.

Theory will be developed to treat the interactions between intense high frequency electromagnetic waves at or close to the plasma frequency with auroral plasma. The effects of electron density gradient and of a magnetic field nearly parallel to that gradient will be included. The amplitude of electrostatic waves generated will be determined.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0009, THEORY OF STRONG CONFIGURATION INTERACTION IN ATOMIC TRANSITION
T. Chang, University of Southern California, School of Letters Arts & Sciences, Dept. of Physics, *3551 University Ave., Los Angeles, California* 90007 (PHY80-09146)

Research in theoretical atomic physics initiated under NSF grant PHY78-09621 will be continued. Among the topics to be investigated are: 1) autoionization state of alkaline earth atom; 2) connection of the multichannel quantum defect theory (MQDT) to the study of autoionization series; 3) application to the generation of tunable Lyman-alpha coherent radiation by four-wave mixing technique; 4) transition from selected excited state; and 5) simultaneous photoionization with photoexcitation and double photoionization.

This is the first 22 months of a 40-month continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0010, TURBULENCE AND WAVE-PARTICLE INTERACTIONS IN SOLAR-TERRESTRIAL PLASMAS
G.A. Dulk, University of Colorado, Boulder Campus, School of Arts & Sciences, Dept. of Astro Geophysics, *1200 University Ave., Boulder, Colorado* 80302 (NAGW 91)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

8.0011, DYNAMIC PHASES OF STELLAR EVOLUTION
J.R. Buchler, State University System of Florida, University of Florida, College of Liberal Arts & Sciences, Dept. of Physics, *208 Tigert Hall, Gainesville, Florida* 32601 (AST79-20024)

The main thrust of this research project will be on calculations involving supernova explosions. The emphasis will be placed on eliminating the physical uncertainties in existing models (in particular, in the equation of state) and on examining new ideas concerning convection during the collapse and subsequent expansion of the stellar core. A two-dimensional hydrodynamic study of these effects will be made. The properties of the hot, dense matter in the supernova will be examined using nuclear and statistical mechanics techniques.

There will be studies of oscillatory phenomena taking place during the evolution of stars. There will also be studies of the effects of supernova explosions taking place in binary systems. Such models have been proposed as explanations of the origin of the observed X-ray binary sources.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

8.0012, RADIATION DAMAGE IN SOLIDS
J.S. Koehler, University of Illinois, Urbana Champaign Campus, School of Engineering, Dept. of Physics/Materials Research Laboratory, *207 Engineering Hall, Urbana, Illinois* 61801 (EY-76-C-02-1198)

We are attempting to understand the behavior of irradiation-produced defects in hexagonal and in body-centered cubic (BCC) metals. New annealing peaks at 1.8 K and 2.2 K have been seen in cadmium. These peaks can be annealed by low-energy electron irradiation. A theory of the continuous annealing seen in the BCC pure metals in the stage II temperature region has been devised. Additional experiments are underway on magnesium, zinc, and cadmium. We aim to determine the temperature required for long-range interstitial migration in these metals. Calculations on the electrical properties of layered materials with layers 10 angstrom units thick are being made. We also hope to do experiments using layers of aluminum and gold. Attempts are being made to determine x-ray emission from 3 MeV electrons during their passage through gold single crystals which are about 10 to the minus 5th power cm thick.

SUPPORTED BY U.S. Dept. of Energy

8.0013, RESEARCH STUDY ENTITLED A RECOVERABLE PLASMA DIAGNOSTICS PACKAGE FOR SPACELAB
S.D. Shawhan, University of Iowa, School of Liberal Arts, Dept. of Physics & Astronomy, *Jessup Hall, Iowa City, Iowa* 52240 (NAS 8-33770)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

8.0014, COLLISIONS OF IONS WITH HIGHLY EXCITED ATOMS

K.B. MacAdam, University of Kentucky, College of Arts & Sciences, Dept. of Physics & Astronomy, *Limestone & Euclid, Lexington, Kentucky* 40506 (PHY80-07630)

Collisions between Na atoms in highly excited (Rydberg) states and 200-2000 eV He, Ne, and Ar ions will be studied in a crossed-beam experiment. Na atoms will be laser-excited to ns and nd states (n equals 20-34) at the crossing point of ion and atomic beams. To be investigated are: 1) n and l-changing collisions, 2) collisional ionization of Na(nl), and 3) charge transfer from Na (nl) to X(n'l'), where X equals He, Ne, or Ar. The ion beam energies span the region of velocity match between the ion and Rydberg electron. The n and l-changing collisions will be detected by using time-resolved field ionization of Rydberg atoms in the interaction region. Electron loss (ionization plus charge transfer) will be measured by counting Na ions left in the interaction region after ion collisions. Charge transfer will be studied by passing the emergent neutralized beam through a field ionization detector. Understanding of these processes is a significant adjunct to studies of magnetic fusion plasmas, laser design, and laser isotope separation, and provides data useful for astrophysical studies. The particular species under study are intended as prototypes with which widely applicable theoretical approaches may be tested and from which generalizations to other species may be drawn.

This is the first year of a two-year continuing grant, currently supported under NSF grant PHY78-00923A01.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0015, MATERIAL SUPPORT TECHNOLOGY STRUCTURE OF INSULATING FILMS

R.L. Park, University of Maryland, College Park Campus, School of Arts & Sciences, Dept. of Physics & Astronomy, *College Park, Maryland* 20742 (DN775707; N00014-77-C-0485)

Improvements in solid state electron devices and development of new devices will require better understanding and control of the thin insulating films which are formed and deposited on the device surface. Many transistor devices used in Navy communications and surveillance systems use insulating films under device control electrodes or for surface passivation. Understanding and controlling the properties of the films is very important for future developments.

By analysis of the energies of electrons emitted from bulk solids following excitation of an atom by x-rays it has been demonstrated that the local atomic structure around the atom can be deduced. Bombardment by fast electrons will excite atoms just as easily, except the electrons do not penetrate beyond a few atomic layers of the surface. The technique of extended appearance potential fine structure (EAPFS) has been developed to explore the properties of surface films, with the goal of deducing the local properties of a near surface atom excited by incident electrons. The emission of secondary electrons is influenced by the nearest neighbors thereby leading to data on local environments. These techniques are applied to insulators on silicon and III-V compound semiconductors. Correlation of structural and electrical properties of the films will be made.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0016, COHERENT SCATTERING OF VISIBLE LIGHT INTO HIGH FREQUENCY RADIOWAVES

J. Weber, University of Maryland, College Park Campus, School of Arts & Sciences, Dept. of Physics & Astronomy, *College Park, Maryland* 20742 (DF049540; AFOSR-77-3399)

AF function - Air Force functions of surveillance, detection, and communication are susceptible to the problem of induction of radio and microwaves when laser beams impinge on radar system supports. Opportunity - successful conclusion of the project offers the possibility of ameliorating the problem. Objective - to investigate experimentally and theoretically a novel experiment in the conversion of visible light to high frequency radio waves - the interior of a coaxial cavity filled with distilled water was illuminated by visible white light of an intensity of a few watts resulting in the increased noise output of a low noise radar receiver (100-140 MHz) by an order of magnitude. How work contributes - identifying the properties of the conversion and clarifying the underlying theory will clarify the mechanisms of the induced radio radiations and indicate techniques for amelioration.

On the experimental side low temperature experiments will be carried out to increase the signal-to-noise ratio and the effect will be investigated with bound electron scatterers in transparent crystals. correlation of the effect with frequency, polarization, and host material will be continued. On the theoretical side calculations will be extended to coherent Raman scattering with a variable stiffness parameter for the electron scatterers, to bound electrons, and in general to fit the calculations into a generic theory of coherent scatterers.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0017, COMMUNICATIONS - GAS LASER RESEARCH

A. Javan, Massachusetts Inst. of Technology, School of Science, Dept. of Physics, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (DN723993; N00014-76-C-0447)

The objective of this work unit is to explore and understand those molecular processes which limit and determine the operation of molecular gas lasers with the goal of enhancing laser efficiency, laser power/energy and wavelength availability. Results of this research program will assist in obtaining an optimum design for molecular lasers which are applicable to Navy requirements for optical reconnaissance, surveillance, communications, guidance, weaponry, fuzing, search and tracking.

Fluorescent emission from high lying electronic states in an excimer excited by a short pulse from a tunable dye laser is used to determine radiative lifetimes, excitation cross sections and quenching rates. High-precision time-resolved measurements are being made of the absorption phenomena and of the growth and decay of the population in the excited states of the rare-gas halides. These measurements are being made as a function of current and gas pressure with several types of rare-gas atoms and molecules. Absolute cross sections will be measured for the rate of production and decay of excited excimers.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0018, STUDY OF CORROSION SPECIES AND INHIBITORS ON ALUMINUM BY INELASTIC ELECTRON TUNNELING SPECTROSCOPY 14881-MS

H.W. White, University of Missouri, Columbia Campus, School of Arts & Sciences, Dept. of Physics, *130 Jesse Hall, Columbia, Missouri* 65201 (DA0F9101; DAAG29-79-C-0152)

To investigate the molecular species present at the microscopic interface between an aluminum surface and a reactive organic medium by inelastic electron tunneling spectroscopy (IETS). Relevance - the proposed research is relevant to degradation of aluminum and other metals in mobility equipment, firepower devices, aircraft structures, lightweight armor and other Army materiel.

Aluminum alloy tunnel junctions will be fabricated and characterized, including obtaining IETS spectra of surface films. Upon exposure to organic corrodents and inhibitors, the interfacial molecular species will be investigated (identity, nature of interaction). These data will be compared to electrochemical studies on the same alloys and on bulk alloys of the same nominal composition. The effect of orientation of adsorbed molecular species will be modelled to develop a theory which relates the IETS relative intensities to the orientation of adsorbed molecules.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0019, ION IMPLANTATION IN PEROVSKITE TYPE FERROELECTRICS 14313-P

R. Gerson, University of Missouri, Rolla Campus, School of Arts & Sciences, Dept. of Physics, *103 Parker Hall, Rolla, Missouri* 65401 (DA0E9273; DAAG29 77 G0001)

To investigate the effect of ion implantation of ferroelectric crystals such as some of the standard barium titanate type materials and some electrooptic materials like lithium niobate, lithium tantalate and bismuth titanate. Relevance - there is a growing body of information which suggests that a good deal of the standard ferroelectric, piezoelectric, pyroelectric properties are, either in whole or in part, dependent on the surface properties of these materials. There are some auguments that suggest that modification of these surfaces would provide a whole new class of devices. Piezoelectrics are used as fuze initiators and pyroelectrics are used as IR detectors.

A broad range of perovskite-type ferroelectric materials will be implanted with hydrogen, oxygen, helium and p and n type metallic dopants. The properties of these materials will then be studied to evaluate some of their device potential.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0020, DYNAMICAL PROPERTIES OF SUPERCONDUCTIVE DEVICES AND MATERIALS

V. Ambegaokar, Cornell University, Ithaca Campus, Lab. for Atomic & Solid State Physics, *Clark Hall, Ithaca, New York* 14850 (DN875658; N00014-78-C-0666)

The objective is to theoretically study the dynamical properties of superconductive devices and materials of interest for future naval surveillance and communications systems.

Microscopically derived equations will be used to study: (1) phase-slip events in filamentary superconductors, (2) superconductive fluctuations in amorphous materials, (3) time dependent effects in weak links and (4) the coupling between nearby weak links.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0021, THEORETICAL STUDIES OF PLASMA CONVECTION AND MAGNETIC FIELD RECONNECTION IN THE SUN AND IN THE EARTH'S MAGNETOSPHERE

R.N. Sudan, Cornell University, Ithaca Campus, School of Engineering, Dept. of Electrical Engineering, *242 Carpenter Hall, Ithaca, New York* 14853 (NAGW 90)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

8.0022, MATERIAL SUPPORT TECHNOLOGY - EXPERIMENTAL STUDIES OF COOPERATIVE PHENOMENA

R.D. Parks, University of Rochester, School of Arts & Sciences, Dept. of Physics & Astronomy, *260 Crittenden Blvd., Rochester, New York* 14627 (DN123455; N00014-80-C-0082)

This work supports Navy programs requiring sensitive command and control systems. Rapid change of physical properties near phase transitions suits certain materials for applications for thermal sensing, switching, sensitive surveillance, and information storage.

The contractor will study specific heat in iron-3-aluminum as a tool for understanding the problem of spin-glasses; alloy materials in which a microscopic number of spins are locked in random orientations below a characteristic temperature tf. When clustering effects are important the system is a mictomagnet. Chemisorption near a ferromagnetic Curie point will be a second item of investigation.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0023, STRUCTURAL AND ELECTRICAL PROPERTIES OF ION IMPLANTED GALLIUM ARSENIDE

M.A. Littlejohn, University of North Carolina, North Carolina State University, School of Engineering, Dept. of Electrical Engineering, *Raleigh, North Carolina* 27607 (DN475218; N00014-75-C-0827)

Advanced Navy electronic systems will use components fabricated from materials using new techniques. Compound semiconductors offer increased capability in electron devices and the technology and physics must be understood and developed for fabricating devices in these materials using ion implantation.

Transmission electron microscopy (TEM) is used to investigate the character and distribution of defects in gallium arsenide (GaAs) and other semiconductors produced by ion implantation. Various types of defects ranging in size from 30 to 500 angstroms are detected and analyzed as a function of depth from the surface. These data are then correlated with analogous depth distribution functions of impurity atom concentration measured by mass spectroscopy at NRL, of photoluminescence measurements and of electrical conductivity by Hall effect measurements. Impurity ions will be implanted into GaAs and InP substrates held at different temperatures, from room temperature up to 350 degrees C. Various annealing conditions and methods will be used to determine optimization procedures.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0024, DIPOLAR DEFECT STRUCTURE OF LASER AND OTHER TRANSPARENT MATERIALS 13440-P

D. Schuele, Case Western Reserve University, Graduate School, Dept. of Physics, *2040 Adelbert Rd., Cleveland, Ohio* 44106 (DA0E9113; DAAG29 76 G0222)

To discover and identify dipolar relaxation phenomena in alkaline earth fluorides and semiconductors and develop an understanding of the mechanisms involved. Relevance - the U.S. Army Metrology and Calibration Center is attempting to develop stable and accurate pressure transducers to replace dead weight piston gauges in Army calibration laboratories throughout the world. This research may lead to near zero temperature-coefficient materials by use of a straightforward doping technique which will advance that effort.

The dielectric constant and dissipation factor will be measured as a function of temperature, pressure, and frequency for solid dielectrics containing dipolar entities. The effect of the addition of dipoles to materials on the temperature coefficient of capacitance will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0025, THEORETICAL STUDIES RELATED TO COMPOSITE PARTICLE SYSTEMS

L.L. Foldy, Case Western Reserve University, School of Science, Dept. of Physics, *2165 Adelbert Rd., Cleveland, Ohio* 44106 (PHY80-10695)

This research comprises theoretical studies in areas related to composite particle systems. Principal emphasis is on the multiple scattering of waves by a system of scatterers, of small dimensions compared to their separation and the wavelength, an important objective being to determine the validity range of an optical potential description and specifically of the 'effective field approximation.' There is no target dynamics and scatterer configurations are treated only statistically. Such problems arise in electromagnetic and acoustic wave propagation in one- and three-dimensional situations (radar and sonar propagation) and in high energy approximations in quantum scattering of particles by bound target systems. Novel and powerful methods recently developed under this program for dealing analytically with the one-dimensional case will be extended to more complex one-dimensional statistical ensembles of scatterers as well as to exploration of the three-dimensional case; the latter has assumed renewed importance in view of the interest in ultrasonic scanning methods in medical diagnostics, biological research, and materials testing. Studies of the stability of Coulomb lattices will also be continued in view of their interest in several areas of condensed state physics and astrophysics. Initiation of explorations in new areas somewhat connected with the above (such as adiabatic approximations), but of interest in their own right will also be considered.

This work is a continuation of that currently supported under NSF grant PHY78-11629A01.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0026, FIFTH SOUND SUPERFLUID GYROSCOPE
J.D. Maynard, Pennsylvania State University, University Park Campus, School of Science, Dept. of Physics, *211 Whitmore Lab., University Park, Pennsylvania* 16802 (DAR79-20925)

The superfluid gyroscope is based on the property of frictionless flow (superfluidity) of liquid helium when cooled below 2.172 degrees K. The superfluid gyroscope described is based on an entirely different principle which gives the gyroscope greatly enhanced immunity to shock and vibration, and eliminates all drift and errors due to friction at high rotation rates and accelerations. Furthermore, the use of a recently discovered superfluid sound mode (fifth sound) in a Doppler rate detection technique will give this gyroscope a greatly enhanced sensitivity. Dr. Maynard will conduct the fundamental superfluid research necessary to determine the feasibility and characteristics of a fifth sound superfluid gyroscope.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Applied Research

8.0027, THEORETICAL STUDIES OF NUCLEAR STRUCTURE AND NUCLEAR REACTIONS
N. Austern, University of Pittsburgh, School of Arts & Sciences, Dept. of Physics, *4200 5th Ave., Pittsburgh, Pennsylvania* 15260 (PHY79-20762)

This work is in the field of theoretical physics with emphasis on studies of interactions of nuclei. Specific problems to be addressed include: 1) Development of improved mathematical methods by which to study the arrangement and motion of the constituent particles of atomic nuclei, and the application of properties of actual nuclei. 2) Mathematical investigations of processes in nuclear collisions, especially for cases in which constituent particles are liberated or new particles are produced. 3) Studies of processes in which unstable mesons are produced from nuclei or collide with nuclei. These three areas of investigation are intended as clarifications and extensions of theoretical ideas, as applications of the theory to existing experiments.

This is the first year of a three-year continuing grant.

This work represents a continuation of that currently supported by NSF grant PHY76-81104A02.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0028, DIFFUSION OF WATER BY NEUTRON SCATTERING
H.E. Rorschach, Rice University, Wiess School of Natural Sciences, Dept. of Physics, *6100 Main, Houston, Texas* 77001 (DN975434; N00014-79-C-0492)

Water makes up 70-90% of the mass of living cells. Quasi-elastic neutron scattering is the most accurate method for measuring the diffusion motion of water molecules. The diffusion of water molecules controls the entry and release of food and energy in cells. An understanding of the true diffusion coefficient of water in living cells will allow a better understanding of the movements of water, electrolytes, and metabolites in shock and disease among Navy personnel.

The self-diffusion coefficient of water molecules in pure solution, in polymer solutions, in biological model systems such as collagen and in brine shrimp, will be measured by the highly accurate techniques of quasi-elastic neutron scattering in collaboration with the Solid State Physics Division at Oak Ridge National Laboratory, Oak Ridge, Tennessee. Pilot experiments have shown that the equipment at Oak Ridge has sufficient resolution to attempt these experiments.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

8.0029, RESEARCH STUDY - INTERACTIVE EXPERIMENTS STUDY
P.M. Banks, Utah Higher Education System, Utah State University, School of Science, Dept. of Physics, *Main Bldg., Office 104, Logan, Utah* 84321 (NAS 8-34003)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

8.0030, RESEARCH AND DEVELOPMENT IN SPECKLE IMAGING
J.W. Sherman, Analytic Information Processing Inc., *Danville, Virginia* 24541 (DF057500; F49620-80-C-0032)

AF function - surveillance and detection of spacecraft - this research effort will stimulate the use of speckle imaging techniques in gathering scientific and military image data with greater resolution than presently attainable. Deficiency - atmospheric seeing precludes the detailed observation of satellites and distant objects with ground based telescopes since passage through the turbulent atmosphere degrades the images. Objective - to understand and compensate for processes which degrade the coherence of light propagating through the atmosphere. Contribution - a capability will be developed to process atmospherically distorted images in order to obtain diffraction limited resolution of space objects from large aperture, ground based, optical systems.

An understanding of the statistical properties of the physical processes which degrade the coherence of light propagating in the atmosphere will be developed. The basic models on which speckle imaging is based will be developed and validated for both isoplanatic and non-isoplanatic conditions. The models of the statistics of the point spread response will be developed from the atmospheric turbulence models and validated with experimental data. The imaging model will be generalized to remove the optically narrow band assumption and make it an explicit function of wavelength. Models describing the effects of various sensors on the measured image will be improved. Equations will be derived to describe the second order statistics computed from a set of speckle images. Reconstruction algorithms will be developed. The accuracy of the performance of the reconstruction techniques will be analyzed in terms of image features and image error at each point. Images of solar filigree and magnetic structure, asteroids, binary stars and other astronomical objects will be reconstructed with improved resolution from the available atmospherically degraded imagery.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0031, MECHANISMS OF RARE-GAS HALIDE LASERS
W. Koechner, Science Applications Inc., *1911 N. Fort Myer Dr., Suite 1200, Arlington, Virginia* 22209 (DN880097; N00173-78-C-0414)

To investigate the mechanisms occurring in rare-gas laser plasmas and to determine the feasibility of generating efficient lasers in this media.

The contractor will develop a kinetics package which describes the atomic, ionic and neutral species reactions in electon-beam sustained rare-gas halide lasers. Diagnostic requirements designed to test the accuracy of the kinetics package will be carried out.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

8.0032, WEAPONRY - SHOCK INDUCED CHEMICAL DECOMPOSITION IN LIQUIDS (ABBREV)
G.E. Duvall, Washington State University, School of Arts & Sciences, Dept. of Physics, *Administration Bldg., Room 101, Pullman, Washington* 99163 (DN775328; N00014-77-C-0232)

The objective of this task is to define the physical and chemical processes that precede the decomposition of simple materials in a shock environment. Shock induced chemical decomposition is the process which is believed to precede all detonations of high energy materials such as explosive armaments and missile propellant formulations.

The approach of this research is to study the time resolved decomposition of simple liquids using a continuous writing rotating mirror spectrograph with a time resolution of 20 nanoseconds and the details of the shock compression using electromagnetic and quartz gages.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, THEORETICAL AND OBSERVATIONAL STUDIES OF THE NOVA OUTBURST AND RELATED OBJECTS

S.G. Starrfield, Arizona State University, School of Liberal Arts, Dept. of Physics, *Tempe, Arizona* 85281 (AST79-21073)

This research will involve studies of the nova outburst, close binary systems, and pulsating white dwarf stars. The effects of varying the chemical composition and the envelope mass of the white dwarf star will be examined. There will be a study on the effect of mass loss in close binary systems made up of a white dwarf star and a red giant star. The effects of mass loss from the red giant star on the nova outburst and on the chemical abundance of the white dwarf envelope will be determined. A study will be made of thermonuclear reactions in the envelopes of neutron stars. There will be both theoretical and observational studies of pulsating white dwarf stars.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

10.0002, PROPOSAL TO OBSERVE WITH THE HIGH ENERGY ASTRONOMICAL OBSERVATORY-B

A. Young, California State University & Colleges, San Diego State University, School of Sciences, Dept. of Astronomy, *5402 College Ave., San Diego, California* 92115 (NAG 8-356)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

10.0003, A HIGH RESOLUTION STUDY OF A VERY DISTANT RICH AND LUMINOUS CLUSTER OF GALAXIES(ABBREV)

J.I. Silk, University of California, Berkeley Campus, School of Letters & Science, Dept. of Astronomy, *Berkeley, California* 94720 (NAG 8-351)

High Energy Astronomical Observatory-2 guest investigator program. A high resolution study of a very distant rich and luminous cluster of galaxies.

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

10.0004, INVESTIGATIONS OF CLOSE BINARY STARS

M. Plavec, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Astronomy, *405 Hilgard Ave., Los Angeles, California* 90024 (AST79-25012)

Drs. Plavec and Popper propose to continue their studies of close binary systems and interacting binary stars. For main sequence systems, Algols, and RS CV stars they will continue deriving masses and fundamental characteristics such as chemical composition and atmospheric structure. Particular emphasis will be placed on the semi-detached binaries, such as the W Sepentis objects, because of the evidence that they contain very hot plasmas. An effort will be made through these studies to gain theoretical insight into the complex structure of interacting systems and the nature of accretion disks.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

10.0005, STUDY OF REFLECTION GRATING SPECTROMETERS FOR X-RAY ASTRONOMY

W.C. Cash, University of Colorado, Boulder Campus, Graduate School, *1200 University Ave., Boulder, Colorado* 80302 (NAG 5-96)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

10.0006, STUDIES IN THE ACCURACY OF RELATIVE MEASUREMENTS

H.K. Eichhorn, State University System of Florida, University of Florida, Graduate School, *Gainesville, Florida* 32601 (NAG 2-46)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

10.0007, OBSERVATIONS OF ABELL CLUSTERS DISCOVERED AS X-RAY SOURCES BY HEAO-A-1, II

M.P. Ulmer, Northwestern University, Evanston Campus, School of Arts & Sciences, Dept. of Physics & Astronomy, *633 Clark St., Evanston, Illinois* 60201 (NAG 8-368)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

10.0008, A SEARCH FOR COMPTON SCATTERED X-RAYS IN SELECTED COMPACT EXTRAGALACTIC OBJECTS

S.L. Mufson, Indiana University, Bloomington Campus, School of Arts & Sciences, Dept. of Astronomy, *Memorial Hall, Bloomington, Indiana* 47401 (NAG 8-365)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

10.0009, LUNAR OCCULTATION STUDIES

W.I. Beavers, Iowa State University of Science & Technology, School of Sciences & Humanities, Dept. of Physics, *Beardshear Hall, Ames, Iowa* 50010 (AST79-12691)

Measurements of the darkening curve as a stellar system is occulted by the moon or conversely of the lightning curve as it reappears can provide detailed information on the small scale structures in the system. The maximum resolution obtained depends strongly on the signal to noise of the observation but for a bright star can approach 2 milliarcseconds - resolution comparable to that obtainable with Very Long Baseline Interferometry (VLBI) in radio astronomy. The results can yield, for example, the spacing and intensity ratio of close binary star systems and the diameter of individual stars.

In the present project it is proposed to continue a lunar occultation program which has been in progress at the Erwin W. Fick Observatory for the past eight years; to improve the telescope to make such observations more numerous and efficient; and to expedite the reduction of previously taken data.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Astronomical Sciences

10.0010, X-RAY INVESTIGATIONS OF SELECTED FIELD IN THE OLD GALACTIC SUPERNOVA REMNANT S147

W.C. Erickson, University of Maryland, College Park Campus, Graduate School, Dept. of Physics & Astronomy, *College Park, Maryland* 20742 (NAG 8-369)

SUPPORTED BY U.S. National Aeronautics & Space Admin., George C. Marshall Space Flight Center

10.0011, FUNDS TO SUPPORT COLLOQUIUM ON CHEMICAL EVOLUTION OF COMETS AND THE ORIGIN OF LIFE ON OCTOBER 29-31, 1980 IN COLLEGE PARK, MARYLAND

C. Ponnamperuma, University of Maryland, College Park Campus, Graduate School, Dept. of Chemistry, *College Park, Maryland* 20742 (NAS 5-26294)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

10.0012, DESIGN, DEVELOPMENT, FABRICATION OF INTERSTELLAR MEDIUM ABSORPTION PROFILE SPECTROGRAPH EXPERIMENT
E.B. Jenkins, Princeton University, Graduate School, Dept. of Astrophysical Sciences, *205 Nassau Hall, Princeton, New Jersey* 08540 (NAS 5-26268)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

10.0013, PROPERTIES OF INTERSTELLAR GRAINS
A.N. Witt, University of Toledo, School of Arts & Sciences, Dept. of Physics & Astronomy, *2801 W. Bancroft St., Toledo, Ohio* 43606 (NAGW 89)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

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VOLUME 19 NUMBER 2/JANUARY 23, 1981

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N81-11007* National Aeronautics and Space Administration, Washington, D. C.

AERONAUTICAL ENGINEERING. A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 126, SEPTEMBER 1980

Sep. 1980 145 p

(NASA-SP-7037(126)) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 01A

This bibliography lists 522 reports, articles, and other documents introduced into the NASA scientific and technical information system in August 1980. A.R.H.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N81-11008 Stanford Univ., Calif.

TURBULENT BOUNDARY LAYER ON A CONVEX, CURVED SURFACE Ph.D. Thesis

Jay Colin Gills 1980 330 p

Avail: Univ. Microfilms Order No. 8024661

Three experiments were performed to determine how boundary layer turbulence is affected by strong convex curvature. The data gathered on the behavior of the Reynolds stress suggested the formulation of a simple turbulence model. Three sets of data were taken on two separate facilities. Both rigs had flow from a flat surface, over a convex surface with 90 deg of turning, and then onto a flat recovery surface. The geometry was adjusted so that, for both rigs, the pressure gradient along the test surface was zero--thus avoiding any effects of streamwise acceleration on the wall layers. After a sudden introduction of curvature, the shear stress in the outer part of the boundary layer is sharply diminished and is even slightly negative near the edge. The wall shear also drops off quickly downstream. In contrast, when the surface suddenly becomes flat again, the wall-shear and shear-stress profiles recover very slowly towards flat-wall conditions. Dissert. Abstr.

N81-11009 Stanford Univ., Calif.

TURBULENT FLOW REATTACHMENT: AN EXPERIMENTAL STUDY OF THE FLOW AND STRUCTURE BEHIND A BACKWARD-FACING STEP Ph.D. Thesis

John Kelly Eaton 1980 178 p

Avail: Univ. Microfilms Order No. 8024646

The reattaching turbulent shear layer behind a two dimensional backward-facing step was studied experimentally. The main objectives were to investigate the behavior of the large-scale turbulent eddies in the flow and to provide new data for comparison with results computed using current turbulence models. The study was conducted in a single-sided, two dimensional, sudden-expansion duct flow with an area ratio of 1.67, a step height of 5.08 cm, and a step span of 61 cm. The working fluid was air at atmospheric conditions, and the inlet velocity ranged from 2-30 m/sec. The boundary thickness at separation was approximately 0.2 heights. Dissert. Abstr.

N81-11010 Stanford Univ., Calif.

SUBSONIC TURBULENT FLOW IN PLANE-WALL DIFFUSERS: PEAK PRESSURE RECOVERY AND TRANSITORY STALL Ph.D. Thesis

Jalal Ashjaee 1980 153 p

Avail: Univ. Microfilms Order No. 8024618

Straight walled, two dimensional diffusers were studied in order to investigate flow behavior in the regime of transitory stall, an intrinsically unsteady flow. Particular attention was paid to the conditions just beyond the regime of no appreciable stall, where the technically important condition of peak pressure recovery at constant N/W sub 1 occurs. Experimental and computational results revealed several features of the flow. At peak recovery, only negligible unsteadiness is present, although instantaneous backflows were observed on both the two diverging walls. Mean wall shear stress does not drop to zero anywhere on either diverging wall at peak recovery. A small, but nevertheless important, cross stream pressure gradient was shown to exist in the transitory stall regime. This pressure gradient changes sign in the vicinity of the detachment point. Dissert. Abstr.

N81-11011# Royal Aircraft Establishment, Farnborough (England).

THE DYNAMICS OF THE OPENING OF A PARACHUTE CANOPY

N. K. Tsyganov Apr. 1980 13 p refs Transl. into ENGLISH from Volny v Sploshnykh Sredakh (Kiev), 1978 p 71-78 (RAE-LIB-TRANS-2032: BR75805) Avail: NTIS HC A02/MF A01

The equation of motion of a parachute inflating under nearly constant velocity conditions in a horizontal trajectory is solved. The canopy geometry during inflation is assumed to be an ellipsoidal envelope of rotation with constant generator length. Empirical functions for porosity, apparent mass, and the variation in canopy mouth radius with time are employed. Calculated forces and shock factors are shown to compare well with results determined from wind tunnel inflation trials. Author

N81-11012*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

TRANSONIC ROTOR NOISE: THEORETICAL AND EXPERIMENTAL COMPARISONS

F. H. Schmitz and Y. H. Yu Nov. 1980 31 p refs (NASA-TM-81236; A-8342; AVRADCOM-TR-80-A-12) Avail: NTIS HC A03/MF A01 CSCL 01A

Two complementary methods of describing the high speed rotor noise problem are discussed. The first method uses the second order transonic potential equation to define and char-

acterize the nature of the aerodynamic and acoustic fields and to explain the appearance of radiating shock waves. The second employs the Ffowcs Williams and Hawkings equation to successfully calculate the acoustic far field. Good agreement between theoretical and experimental waveforms is shown for transonic hover tip Mach numbers from 0.8 to 0.9. Author

N81-11013*# Kentron International, Inc., Hampton, Va.
PRELIMINARY DESIGN CHARACTERISTICS OF A SUBSONIC BUSINESS JET CONCEPT EMPLOYING AN ASPECT RATIO 25 STRUT BRACED WING
R. V. Turriziani, W. A. Lovell, G. L. Martin, J. E. Price, E. E. Swanson, and G. F. Washburn Oct. 1980 101 p refs
(Contract NAS1-16000)
(NASA-CR-159361) Avail: NTIS HC A06/MF A01 CSCL 01A

The advantages of replacing the conventional wing on a transatlantic business jet with a larger, strut braced wing of aspect ratio 25 were evaluated. The lifting struts reduce both the induced drag and structural weight of the heavier, high aspect ratio wing. Compared to the conventional airplane, the strut braced wing design offers significantly higher lift to drag ratios achieved at higher lift coefficients and, consequently, a combination of lower speeds and higher altitudes. The strut braced wing airplane provides fuel savings with an attendant increase in construction costs. Author

N81-11014*# Boeing Vertol Co., Philadelphia, Pa.
FULL SCALE WIND TUNNEL INVESTIGATION OF A BEARINGLESS MAIN HELICOPTER ROTOR Final Report
10 Oct. 1980 608 p refs
(Contract NAS2-10333)
(NASA-CR-152373; D210-11659-1) Avail: NTIS HC A99/MF A01 CSCL 01A

A stability test program was conducted to determine the effects of airspeed, collective pitch, rotor speed and shaft angle on stability and loads at speeds beyond that attained in the BMR/BO-105 flight test program. Loads and performance data were gathered at forward speeds up to 165 knots. The effect of cyclic pitch perturbations on rotor response was investigated at simulated level flight conditions. Two configuration variations were tested for their effect on stability. One variable was the control system stiffness. An axially softer pitch link was installed in place of the standard BO-105 pitch link. The second variation was the addition of elastomeric damper strips to increase the structural damping. The BMR was stable at all conditions tested. At fixed collective pitch, shaft angle and rotor speed, damping generally increased between hover and 60 knots, remained relatively constant from 60 to 90 knots, then decreased above 90 knots. Analytical predictions are in good agreement with test data up to 90 knots, but the trend of decreasing damping above 90 knots is contrary to the theory. A.R.H.

N81-11015# National Aerospace Lab., Tokyo (Japan).
A FORMULATION OF THE THREE-DIMENSIONAL POTENTIAL FLOW FIELD AROUND A LIFTING WING BY USE OF THE SURFACE VELOCITY COMPONENTS: AN EXTENSION OF THE PRAGER-VANDREY-MARTENSEN PROCEDURE TO THE THREE DIMENSIONAL CASE
Masao Ebihara Apr. 1980 41 p refs
(NAL-TR-605T) Avail: NTIS HC A03/MF A01

An integral equation of the second kind for the surface velocity components of the three dimensional incompressible potential flow around a body is obtained by extending the procedure for the two dimensional case. The formulation is based on the representation of the velocity potential by a doublet distribution over the body surface, and is realized by replacing the original surface boundary condition of the vanishing normal velocity component with the equivalent condition of the quiescent flow in the region inside the body. The formation is generalized to cases where the normal velocity component to the body surface does not necessarily vanish identically so that it can be utilized in the boundary layer displacement model procedure designed to account for viscous effects within the scope of the inviscid flow theory. This generalization is accomplished by combining the above-mentioned doublet distribution with a source distribution of prescribed strengths. The behavior of our basic integral equation at the trailing edge of a wing is studied. The geometry of the trailing vortex sheet and the direction of vortex shedding in the immediate neighborhood of the trailing edge bear essential relations to the fulfillment of the Kutta condition. S.F.

N81-11016# ARO, Inc., Arnold Air Force Station, Tenn.
WIND TUNNEL INVESTIGATION OF THE AERODYNAMIC HYSTERESIS PHENOMENON ON THE F-4 AIRCRAFT AND ITS EFFECTS ON AIRCRAFT MOTION Final Report, 1 Oct. 1978 - 31 Oct. 1979
J. F. Herman and E. S. Washington AEDC Sep. 1980 96 p refs Sponsored by Air Force
(AD-A089851; AEDC-TR-80-10) Avail: NTIS HC A05/MF A01 CSCL 20/4

A wind tunnel test program and an analytical study were conducted to investigate aerodynamic hysteresis phenomena on the F-4 aircraft. The wind tunnel test was conducted in the Arnold Engineering Development Center (AEDC) Aerodynamic Wind Tunnel (4T) to investigate the source of aerodynamic hysteresis in static aerodynamic data. The wind tunnel test also provided data that were used in a motion simulation study of the effect of hysteresis on predicted aircraft motion. Static longitudinal lateral directional force and moment data and wing pressure data were obtained on a 0.5 scale model (without pylons or external stores) with various simulated leading-edge slats. These data include the effects of Mach number, angle of attack, model movement, and time dependence on the aerodynamic hysteresis characteristics. Data are presented for the Mach number range from 0.7 to 0.95 at angles of attack from -4 to 24 deg at zero deg sideslip angle and for sideslip angles from -12 to 12 deg at angles of attack of 5, 10, 15, and 20 deg. Six degrees of freedom motion simulation studies were used to assess the effect of hysteresis in the rolling-moment coefficient on the prediction of aircraft motion. Simulations of various flight maneuvers were conducted both with and without hysteresis in the aerodynamic data. GRA

N81-11017# Naval Surface Weapons Center, White Oak, Md. Research and Technology Dept.
A COMPARISON OF NEWTON-LIKE METHODS FOR THE TRANSONIC SMALL DISTURBANCE EQUATION
A. B. Stephens and A. G. Werschulz 24 Jun. 1980 20 p refs
(AD-A090270; NSWC/TR-80-271) Avail: NTIS HC A02/MF A01 CSCL 20/4

We investigate the efficiency of Newton's method and two variants of Newton's method for the numerical solution of the small disturbance equation of non-lifting transonic flow past a parabolic airfoil. In particular, it is shown that the efficiency of Newton's method can be substantially improved with respect to both storage and computational time if the Jacobian matrix is suitably altered. GRA

N81-11018# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THREE DIMENSIONAL INTERACTIONS AND VORTICAL FLOWS WITH EMPHASIS ON HIGH SPEEDS
David J. Peake, Murray Tobak, and Robert H. Korkegi, ed. Jul. 1980 226 p refs
(AGARD-AG-252) Avail: NTIS HC A11/MF A01

Diverse kinds of three dimensional regions of separation in laminar and turbulent boundary layers are discussed that exist on lifting aerodynamic configurations immersed in flows from subsonic to hypersonic speeds. In all cases of three dimensional flow separation, the assumption of continuous vector fields of skin-friction lines and external flow streamlines, coupled with topology laws, provides a flow grammar of nodes, foci and saddles. Sequences of plausible flow structures are created, mean flow characteristics deduced and flow mechanics exposed. S.F.

N81-11019# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
COMPARISON OF UNSTEADY PRESSURE FIELDS COMPUTED AND MEASURED ON THE ZKP MODEL
M. Couston, J. J. Angelini, and J. P. Meurzec Aug. 1980 21 p refs In FRENCH; ENGLISH summary Presented at the 50th Conf. of the Commission on Structures and Materials, Athens, Apr. 1980
(AGARD-R-688; ISBN-92-835-2107-2) Avail: NTIS

HC A02/MF A01

The unsteady pressure fields prediction for a supercritical wing is considered from a bidimensional nonlinear method corrected for tridimensional interactions between strips using an asymptotic approximation. This approximation is derived for a wing with large aspect ratio and low sweep angle. An application of this method to a real case is described. Oscillation of the control surface on a rigid model in a transonic wind tunnel is considered. M.G.

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N81-11020# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

THE TURBULENT WIND AND ITS EFFECT ON FLIGHT

Bernard Etkin Aug. 1980 93 p refs

(UTIAS-Review-44; CN-ISSN-0082-5247) Avail: NTIS HC A05/MF A01

An overview of the problems posed for aviation by turbulent winds is presented. The technical issues, especially for design, simulation and certification, are delineated and commented upon. The present state of knowledge of turbulence at altitude and of the wind and turbulence near the ground are reviewed. The input/response problem is discussed in depth, with special attention to the requirement for unsteady aerodynamics and how it can be fulfilled. The four point model of the airplane is introduced and developed, and an extension made to the existing spectral theory of response to two dimensional inputs. Passenger comfort, gust alleviation, and representation of turbulence in piloted flight simulators are discussed. S.F.

N81-11021# RANN, Inc., Palo Alto, Calif.

EXPLORATORY STUDY OF HAZARD MITIGATION AND RESEARCH IN THE AIR TRANSPORT SYSTEM Final Report

R. L. Bisplinghoff, P. G. Dembling, A. J. Eggers, Jr., C. W. Harper, and J. D. Young 31 Mar. 1980 99 p refs

(AD-A089204; EMW-00432) Avail: NTIS HC A05/MF A01 CSCL 13/12

The study examines a series of principles that may effectively mitigate technological hazards within the Air Transport System. These principles are: precise design criteria and verification of the standards which relate to an airplane:s operating environment; quality control in manufacturing with high levels of performance in design, construction, inspection, and maintenance of the system; periodic testing and evaluation of equipment and human elements to meet performance standards; training and education of key managers and operators in emergency procedures with emphasis in new systems and multi-problem hazards; establish communication modes linking key elements with institutions in the system to mitigate, respond, and recover from emergencies; a system of reporting incident and accident investigations in a prompt manner to allow for a coordinated recovery; and the system must be regulated, audited, and demonstrated frequently to protect public interest, including proper liability. These principles are then analyzed in three areas in which successful hazard mitigation will reduce the effects of increased technological applications. These topic areas include: design, construction, inspection, and maintenance; system development and operation; and liability and regulation. The study concludes that with the rapid development in high technology and with its subsequent rapid application to our national capability, technological hazards converge onto a wide variety of societies' activities. The report suggests that successful mitigation of technological hazards can be achieved through utilizing the previously outlined principles within the total air transport system environment. GRA

N81-11022# Federal Aviation Administration, Atlantic City, N.J.

SUMMARY OF FEDERAL AVIATION ADMINISTRATION RESPONSES TO NATIONAL TRANSPORTATION SAFETY BOARD SAFETY RECOMMENDATIONS Quarterly Report, Apr. - Jun. 1980

J. R. Harrison et al Jul. 1980 167 p

(AD-A089971; FAA-ASF-80-2; ASF-300) Avail: NTIS HC A08/MF A01 CSCL 01/2

This report contains NTSB recommendations and all FAA responses to Board recommendations that were delivered to the Board during the applicable quarter. In addition, the report includes NTSB requests and FAA responses concerning reconsiderations, status reports, and followup actions. The table of contents for this report reflects only those NTSB recommendations which are still open pending FAA action (i.e., those that have not been designated as 'closed' by the NTSB as a result of acceptable action). Accordingly, the table of contents may reflect a number of multiple recommendations (example: A-80-5 through 7), but background material is included only for those recommendations which remain in an 'open' status. Background information for those recommendations which have been closed is available in FAA headquarters files. GRA

N81-11023# Civil Aeronautics Board, Washington, D.C. Financial and Traffic Data Section.

AIRPORT ACTIVITY STATISTICS OF CERTIFICATED ROUTE AIR CARRIERS, CALENDAR YEAR 1979

31 Dec. 1979 357 p Prepared in cooperation with FAA, Washington, D.C.

(AD-A089748) Avail: NTIS HC A16/MF A01 CSCL 01/2

This report furnishes airport activity of the Certificated Route Air Carriers. Included in the data contained in Table 6 are passenger enplanements, tons of enplaned freight, express, and mail. Both scheduled and non-scheduled service, and domestic and international operations are included. These data are shown by airport and carrier. Table 7 includes departures by airport, carrier and type of operation, and type of aircraft. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N81-11024# Federal Aviation Administration, Atlantic City, N.J. Technical Center.

PROCEEDINGS OF THE 1979 SEMINAR ON AIR TRAFFIC CONTROL TERMINAL RADAR APPROACH CONTROL (TRACON) FACILITY SUPERVISORY DESK COMPLEX Progress Report, Nov. 1979 - Feb. 1980

Paul Zito, John Goodwin, Felix Hierbaum, Michael Massimino, and Tom E. Zurinskas Aug. 1980 107 p Seminar held at Atlantic City, N.J.

(FAA Proj. 219-151-140)

(AD-A089914; FAA-CT-80-170; FAA-RD-80-105) Avail: NTIS HC A06/MF A01 CSCL 17/7

With the planned construction of new control tower and TRACON facilities, the Federal Aviation Administration (FAA) has established a need for standardized supervisory desk complexes. The Air Traffic Control (ATC) Systems Applications Branch (ACT-210) at the Federal Aviation Administration (FAA) Technical Center conducted a study of selected field facilities. In addition, a seminar was held at the Technical Center which resulted in recommending several different supervisor's desk designs for future implementation at new facilities or as useful, functional, and efficient replacements for existing TRACON installations. GRA

N81-11025# Federal Aviation Administration, Atlantic City, N.J.

NEW TERMINAL RADAR APPROACH CONTROL IN TOWER CAB CONCEPT FOR LOVE FIELD, DALLAS, TEXAS Final Report, Mar. - May 1980

Donald Bottomley, Edward G. Ezekiel, and Thomas Zurinskas

Aug. 1980 17 p
(AD-A089996; FAA-CT-80-40; FAA-RD-80-79) Avail: NTIS HC A02/MF A01 CSCL 17/7

This study was accomplished in response to a request from Air Traffic Service (AAT-100), for development of a mockup to evaluate a centrally positioned terminal radar approach control in a tower cab (TRACAB) console. Presently, the Local Control position at Love Field, Dallas, Texas, generally faces both southeast runways, with all the attendant instrumentation in front of the controller. However, when conditions dictate a northwest operation, the Local Controller must turn away to see and sequence his traffic. The work effort addressed the relocation of operational positions from their usual peripheral sites in the tower cab to a unique four-winged central console with each wing having its own instrumentation. This console housed two Local Control and two Airport Surveillance Radar (ASR) positions on one side of the console and a Ground Control position on the opposite side with identical instrumentation. These five positions were endowed with a 'flip/flop' capability as traffic dictated. The other two positions, Clearance Delivery/Flight Data and Watch Supervisor, remained constant at each end of the console, regardless of traffic flow. While the four-winged central console solved the Local Controller's instrumentation availability, it reflected two problems. Limited room on the console caused overcrowding and resultant overheating of the operational equipment. Local Control perambulation was restricted due to the two ASR controllers and tower peripheral boundaries. Since few airports require the 'flip/flop' design necessary by a tower located between dual runways, it was concluded that no further evaluation of this console concept would be made. GRA

N81-11026# Federal Aviation Administration, Atlantic City, N.J. Office of Systems Engineering Management.
ATARS IMPLEMENTATION TRADEOFF
Robert W. Sittler and Karl Seiler, III Jul. 1980 108 p refs
(AD-A089977; FAA-EM-80-10; AEM-200) Avail: NTIS HC A06/MF A01 CSCL 01/2

The study is a comparative analysis of the costs and benefits from competing distributed and centralized ATARS architectures. The current DABS/ATARS structure is a distributed one; a new architecture is postulated for deployment as a centralized ATARS system. Distributed and centralized ATARS are compared as to performance, cost, reliability, maintainability, vulnerability and growth potential. Performance and reliability are treated as constraints to be met equally by all architectures. Maintainability is included in cost. The cost analysis including cost sensitivities forms the bulk of the study. It is found that centralization of most sites is more costly than a distributed deployment and that the individual sites which contribute most to a cost advantage for centralization lie in high density terminal areas. A most significant finding is that centralized ATARS is inferior to distributed ATARS in vulnerability. The options are about equal in growth potential. GRA

N81-11027# Naval Surface Weapons Center, Dahlgren, Va.
APPLICATION OF NAVSTAR GPS GEODETIC RECEIVER TO GEODESY AND GEOPHYSICS Final Report
Richard J. Anderle Sep. 1980 26 p refs
(AD-A090003; NSWC/TR-80-282) Avail: NTIS HC A03/MF A01 CSCL 17/7

A prototype geodetic receiver is being developed for application with the NAVSTAR Global Positioning System. Data obtained with an experimental version of the receiver applied to simulations of performance of the prototype version indicate that the relative positions of stations 10 to 100 km apart can be obtained with 1 to 2 cm accuracy after 6 hr of observations provided that water-vapor radiometers are used to obtain tropospheric refraction correction data. Initial studies show that the use of surface weather data, but without water-vapor radiometers, would give 2 to 5 cm accuracies, but a more realistic modeling of the errors under these conditions is required. GRA

N81-11028# Lincoln Lab., Mass. Inst. of Tech., Lexington.
FORMATS FOR DABS DATA LINK APPLICATIONS
J. L. Leeper and R. S. Kennedy 30 Jul. 1980 34 p refs
(Contract F19628-80-C-0002; DOT-FA78WAI-895)
(AD-A089963; ATC-96; FAA-RD-80-81) Avail: NTIS HC A03/MF A01 CSCL 01/2

The purpose of this paper is to describe formats developed for transmitting aviation-related messages over the Discrete Address Beacon System (DABS) data link. Initial data link applications include: Minimum Safe Altitude Warning (MSAW) alerts (Terminal Area); Takeoff Clearance Confirmation; Altitude Assignment Clearance Confirmation (Enroute); Weather Reports; Enhanced Terminal Information Service (ETIS); Downlink of Airborne Measurements. The formats described in this paper cover the DABS communications formats for uplink messages from the DABS sensor to the airborne data link system, and the downlink messages from the aircraft. Downlink messages include pilot requests for routine weather information and ETIS service, pilot acknowledgements for uplink tactical messages, and airborne measurements. GRA

N81-11029# National Bureau of Standards, Boulder, Colo.
FOURIER TRANSFORMATION OF THE NONLINEAR VOR (VERY HIGH FREQUENCY OMNIDIRECTIONAL RANGE) MODEL TO APPROXIMATE LINEAR FORM
Dominic F. Vecchia Jun. 1980 31 p refs
(PB80-207145; NBS-TN-1021) Avail: NTIS HC A03/MF A01 CSCL 17G

A method is described for transforming a particular nonlinear regression model to a form which is approximately linear in the unknown parameters. The technique involves computation of the Fourier coefficients for a set of sample data and uses phase variables to estimate the parameters. The phase spectrum transformation is employed to obtain bearing angle estimates for a model associated with the very high frequency omnidirectional range (VOR) aircraft navigation system. The transformation provides a model linear in relevant phase parameters. Thus, estimation of VOR bearing angle utilizes existing statistical theory. It is shown that certain generalizations of the VOR model also are reduced to approximate linear form by the phase spectrum transformation. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N81-11030 Michigan Univ., Ann Arbor.
IMPROVED AIRCRAFT CRUISE BY PERIODIC CONTROL Ph.D. Thesis
Daniel Thomas Lyons 1980 302 p
Avail: Univ. Microfilms Order No. 8025721

The possibility of improving aircraft cruise by periodic motion was investigated for subsonic aircraft with jet engines. Three cruise problems were studied: maximum range, maximum endurance, and peak altitude. Normal steady state cruise was compared with periodic cruise in which the controls and state variables were time-dependent periodic functions. Periodic cruise results in improved performance under certain circumstances. Periodic cruise gives greater peak altitudes than are possible with steady state cruise. A state inequality constraint which limits the peak altitude is required to retain dynamic pressure for aerodynamic control at the peak altitude. A large energy height is desirable for maximum peak altitude. However, the period increases rapidly as the energy height approaches the maximum energy height for steady cruise. Dissert. Abstr.

N81-11031*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
A COMPUTER PROGRAM FOR CYCLIC PLASTICITY AND STRUCTURAL FATIGUE ANALYSIS
I. Kalev Nov. 1980 43 p refs Sponsored by NASA and NAS-NRC
(NASA-CR-163101; H-1139) Avail: NTIS HC A03/MF A01 CSCL 01C

A computerized tool for the analysis of time independent cyclic plasticity structural response, life to crack initiation prediction, and crack growth rate prediction for metallic materials is described. Three analytical items are combined: the finite

element method with its associated numerical techniques for idealization of the structural component, cyclic plasticity models for idealization of the material behavior, and damage accumulation criteria for the fatigue failure. Author

N81-11032*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BIBLIOGRAPHY ON AERODYNAMICS OF AIRFRAME/ENGINE INTEGRATION OF HIGH-SPEED TURBINE-POWERED AIRCRAFT, VOLUME 1
Mark R. Nichols Nov. 1980 92 p refs
(NASA-TM-81814; L-13251-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 01C

This bibliography was developed as a first step in the preparation of a monograph on the subject of the aerodynamics of airframe/engine integration of high speed turbine powered aircraft. It lists 1535 unclassified documents published mainly in the period from 1955 to 1980. Primary emphasis was devoted to aerodynamic problems and interferences encountered in the integration process; however, extensive coverage also was given to the characteristics and problems of the isolated propulsion system elements. A detailed topic breakdown structure is used. The primary contents of the individual documents are indicated by the combination of the document's title and its location within the framework of the bibliography. T.M.

N81-11033# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.
EXPERIMENTAL AND ANALYTICAL STUDIES OF A MODEL HELICOPTER ROTOR IN HOVER
F. X. Caradonna and C. Tung 1980 20 p refs Presented at the European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980
(AD-A089780; Rept-25) Avail: NTIS HC A02/MF A01 CSCL 20/4

The present study is a benchmark test to aid the development of various rotor performance codes. The study involves simultaneous blade pressure measurements and tip vortex surveys. Measurements were made for a wide range of tip Mach numbers including the transonic flow regime. The measured tip vortex strength and geometry permit effective blade loading predictions when used as input to a prescribed wake lifting surface code. It is also shown that with proper inflow and boundary layer modeling, the supercritical flow regime can be accurately predicted. GRA

N81-11034# Martin Marietta Corp., Baltimore, Md.
CONTAINER LIFE ADAPTER-HELICOPTER (CLAH) OPERATIONAL PROTOTYPE (PREPRODUCTION) MILITARIZED UNITS FOR FLIGHT EVALUATION AND OPERATIONAL TESTING Final Report, Sep. 1978 - Apr. 1980
Edgar G. Ball Aug. 1980 76 p
(Contract DAAK51-78-C-0026; DA Proj. 1L1-62209-AH-76) (AD-A089794; ER-15047; USAAVRADCOM-TR-80-D-20) Avail: NTIS HC A05/MF A01 CSCL 01/3

This report covers the efforts required to manufacture and test two operational preproduction militarized CLAHs for Army flight evaluation and operational suitability. The CLAH is an external load-carrying device that is suspended under a cargo helicopter and enables the helicopter flight crew to automatically align with, engage, lock on, pick up, transport, and deposit an 8 x 8 x 20 foot MILVAN or commercial container without assistance of ground crew. This production prototype CLAH design has evolved from a series of contracts involving research, study, development, and testing of experimental container lifting devices. The design change per this contract included eliminating the retractable guide system and the pyrotechnic emergency jettison system. Reliability, maintainability, logistic and cost analyses were conducted, and orientation/training sessions were provided to enable Government personnel to operate, maintain, repair, and provide logistic support for the CLAH field test program. GRA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N81-11035# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, Va. Manpower and Educational Systems Technical Area.
HELICOPTER ELECTRO-OPTICAL SYSTEM DISPLAY REQUIREMENTS. 1. THE EFFECTS OF CRT DISPLAY SIZE, SYSTEM GAMMA FUNCTION, AND TERRAIN TYPE ON PILOTS REQUIRED DISPLAY LUMINANCE
Aaron Hyman, Richard M. Johnson, and Paul A. Gade Mar. 1980 29 p refs
(DA Proj. 2Q1-62722-A-765)
(AD-A089755; ARI-TR-441) Avail: NTIS HC A03/MF A01 CSCL 05/8

Twenty-four Army helicopter pilots viewed videotaped segments of low-level and nap-of-the-Earth (NOE) helicopter flights as presented on television monitors designed to simulate an airborne low-light-level television cockpit display system. While viewing these displays in an environment having no additional ambient illumination, these pilots were asked to set cockpit monitor luminance at the lowest level that they judged would permit successful flight control over the terrain being overflown. Each pilot adjusted luminance levels for eight different display conditions formed by the factorial combination of display size, type of terrain, and object-luminance to display-luminance transfer function (system gamma function). Results show that pilots used lower luminance settings when viewing the larger of the two display sizes presented. They also used significantly lower luminance settings when viewing wooded terrain, with the system gamma function modified to provide 'enhanced' contrast in the luminance range of interest, as against an unmodified system gamma function. The pilot's subjective impressions agreed with their measured settings. This report discusses the impact of these results on the specifications of display requirements for a low light-level television system for aiding night NOE flight. GRA

N81-11036# Aircraft Research and Development Unit, Edinburg (Australia).
FITMENT OF TAMAM STANDBY ATTITUDE INDICATORS TO MACCHI AIRCRAFT Engineering Report
D. K. King Aug. 1980 17 p
(AD-A089378; TI-683) Avail: NTIS HC A02/MF A01 CSCL 01/4

The Aircraft Research and Development Unit reworked Macchi MB 326H Draft Modification Order No 365 to install the 'TAMAM' Standby Attitude Indicator (SAI) in the front and rear instrument panels of Macchi aircraft. Modifications were also developed to provide independent switching and circuit protection for each SAI on the existing FIRE/OVERHEAT panel in the Right hand console of the front cockpit. RPM indicator lighting control was transferred from its individual rheostat to the panel lighting control and protection circuit. The modification was successfully test flown with particular emphasis on instrument readability, lack of conflict with the flight controls and ease of operation. Residual errors noted in the SAIs after maneuvers were large but were immediately cancelled by operation of the caging knob. Trial flying of the installation showed the modification to be operationally acceptable and fleet wide installation was recommended. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N81-11037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LOW-SPEED AERODYNAMIC PERFORMANCE OF 50.8-CENTIMETER-DIAMETER NOISE-SUPPRESSING INLETS FOR THE QUIET, CLEAN, SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE)

John M. Abbott, James H. Diedrich, and Robert C. Williams Aug. 1978 37 p refs

(NASA-TP-1178; E-9542) Avail: NTIS HC A03/MF A01 CSCL 21E

Two basic inlet concepts, a high throat Mach number (0.79) design and a low throat Mach number (0.60) design, were tested with four diffuser acoustical treatment designs that had face sheet porosity ranging from 0 to 24 percent for the high Mach number inlet and 0 to 28 percent for the low Mach number inlet. The tests were conducted in a low speed wind tunnel at free stream velocities of 0, 41, and 62 m/sec and angles of attack to 50 deg. Inlet throat Mach number was varied about the design value. Increasing the inlet diffuser face sheet porosity resulted in an increase in total pressure loss in the boundary layer for both the high and low Mach number inlet designs, however, the overall effect on inlet total pressure recovery of 0.991 at the design throat Mach number, a free stream velocity of 41 m/sec, and an angle of attack of 50 deg; Inlet flow separation at an angle of attack of 50 deg was encountered with only one inlet configuration the high Mach number design with the highest diffuser face sheet porosity (24 percent). A.R.H.

N81-11038*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. Propulsion Lab.

OFF-DESIGN PERFORMANCE LOSS MODEL FOR RADIAL TURBINES WITH PIVOTING, VARIABLE-AREA STATORS

Peter L. Meitner and Arthur J. Glassman Nov. 1980 15 p refs

(NASA-TP-1708; AVRADCOM-TR-80-C-13; E-455) Avail: NTIS HC A02/MF A01 CSCL 21E

An off-design performance loss model was developed for variable stator (pivoted vane), radial turbines through analytical modeling and experimental data analysis. Stator loss is determined by a viscous loss model; stator vane end-clearance leakage effects are determined by a clearance flow model. Rotor loss coefficient were obtained by analyzing the experimental data from a turbine rotor previously tested with six stators having throat areas from 20 to 144 percent of design area and were correlated with stator-to-rotor throat area ratio. An incidence loss model was selected to obtain best agreement with experimental results. Predicted turbine performance is compared with experimental results for the design rotor as well as with results for extended and cutback versions of the rotor. Sample calculations were made to show the effects of stator vane end-clearance leakage. Author

N81-11039*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SURFACE PYROMETRY IN PRESENCE OF RADIATION FROM OTHER SOURCES WITH APPLICATION TO TURBINE BLADE TEMPERATURE MEASUREMENT

Donald R. Buchele Nov. 1980 19 p refs

(NASA-TP-1754; E-396) Avail: NTIS HC A02/MF A01 CSCL 21E

Surface pyrometry is feasible even when the amount of surface radiation is exceeded by radiation from surrounding sources. To measure and correct for this interfering radiation, several methods that use multiple wavelength pyrometry were compared by an error analysis. For a specific application to turbine blade temperature measurement in a turbofan engine, a two wavelength method was best. Auxiliary measurements at the same wavelengths substantially improve the accuracy of the method. S.F.

N81-11040# ARO, Inc., Arnold Air Force Station, Tenn.

AN EVALUATION OF STATISTICAL METHODS FOR THE PREDICTION OF MAXIMUM TIME-VARIANT INLET TOTAL PRESSURE DISTORTION Final Report, 1 Oct. 1978 - 24 Sep. 1979

Marvin E. Sanders and Richard E. Christenson AEDC Sep. 1980 56 p refs Sponsored by Air Force

(AD-A089817; AEDC-TR-79-77) Avail: NTIS HC A04/MF A01 CSCL 21/5

An analysis was conducted to determine the accuracies and limitations of three statistical methods used to predict engine-face maximum time-variant total pressure distortion. The statistical methods have all been proposed as low-cost alternatives to the time-consuming and costly deterministic method generally used for reducing engine-face time-variant total pressure data. The statistical methods are evaluated by comparing their predicted distortion values and patterns to those measured with the deterministic method. Data comparisons from tests of four different inlet models, covering a wide range of Mach numbers, mass flow ratios, model attitudes, and distortion factors, were used during the analysis. The results show good agreement between the measured and predicted values for all three statistical methods. The distortion pattern predictions, however, were inadequate at conditions with high total pressure fluctuation (turbulence). It is recommended that improvements continue to be made in the statistical methods, particularly adjustments for high turbulence conditions, and that the Melick method be used as an on-line distortion analysis tool for inlet performance tests. GRA

N81-11041# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.

DISK RESIDUAL LIFE STUDIES. PART 1: F100 1ST-STAGE TURBINE DISK (IN100)

J. S. Cargill, J. K. Malpani, and Y. W. Cheng Dec. 1979 108 p refs

(Contract F33615-77-C-5172; AF Proj. 7351)

(AD-A089791; PWA-FR-11878-Vol-1; AFML-TR-79-4173-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 21/5

A residual fatigue life prediction method, suitable for Retirement-for-Cause application, has been developed for two P WA turbine disks: the F100 1st-stage high pressure turbine disk and the TF30 10th-stage compressor disk. The method is based upon interaction of fracture mechanics crack propagation modeling concepts with laboratory nondestructive evaluation (NDE) techniques. Fracture mechanics life models were developed using the GPD hyperbolic sine (SINH) model refined during an earlier Air Force Materials Laboratory (AFML) program. Stress intensity (K) solutions for the engine components were based upon experimental effective K determinations made during full-scale component fatigue tests. The NDE techniques developed for disk inspections included acoustic emission (AE), eddy current (EC), and fluorescent penetrants (FP). Stress-enhanced penetrant and semi-automated rotating probe EC techniques were developed as periodic inspections, while the AE time-domain technique was developed as a real-time inspection tool. GRA

N81-11042# RAND Corp., Santa Monica, Calif.

AIRCRAFT TURBINE ENGINE MONITORING EXPERIENCE. AN OVERVIEW AND LESSONS LEARNED FROM SELECTED CASE STUDIES Interim Report

John L. Birkler and J. R. Nelson Aug. 1980 115 p refs

(Contract F49620-77-C-0023)

(AD-A089752; RAND/R-2440-AF) Avail: NTIS HC A06/MF A01 CSCL 21/5

Two approaches have evolved in attempts to improve engine operations, maintenance, and management while reducing support costs. The first concentrates on short-term practices (inflight data are recorded in a snapshot mode). The second approach focuses on long-term benefits through improved knowledge of the operating environment. (Data must be recorded continuously on at least a few aircraft.) Engine duty-cycle research by the military services has demonstrated that neither the services nor the manufactures have a clear idea of power requirements and frequent throttle movements during operational sorties in fighter aircraft and have generally overestimated engine parts life and underexpected life-cycle costs. The narrow concept of cost savings over the short term should not be the sole criterion on which monitoring systems are judged. Monitoring systems for recent and future engines should include continuously recorded data now that reliability, durability, and cost issues are almost on an equal footing with performance. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N81-11043*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATING STUDY OF THE INTERACTION BETWEEN THE PROPULSION AND FLIGHT CONTROL SYSTEMS OF A SUBSONIC LIFT FAN VTOL
Bruce E. Tinling and Gary L. Cole Nov. 1980 50 p refs
(NASA-TM-81239; A-8346) Avail: NTIS HC A03/MF A01 CSCL 01C

The possibility of interactions between the propulsion and flight control systems of a three-fan subsonic VTOL aircraft was studied using nonreal time simulation. Time histories of critical internal engine parameters were obtained and possible deleterious effects of engine dynamics on flight control were identified and analyzed. No deleterious effects, with the exception of the effects of the fan actuator deadband, were found. A method of alleviating these effects through feedback of the actuator output to the flight controller was developed. T.M.

N81-11044*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT EVALUATION OF STABILIZATION AND COMMAND AUGMENTATION SYSTEM CONCEPTS AND COCKPIT DISPLAYS DURING APPROACH AND LANDING OF POWERED-LIFT STOL AIRCRAFT
James A. Franklin, Robert C. Innis, and Gordon H. Hardy Nov. 1980 94 p refs
(NASA-TP-1551; A-7968) Avail: NTIS HC A05/MF A01 CSCL 01C

A flight research program was conducted to assess the effectiveness of manual control concepts and various cockpit displays in improving altitude (pitch, roll, and yaw) and longitudinal path control during short takeoff aircraft approaches and landings. Satisfactory flying qualities were demonstrared to minimum decision heights of 30 m (100 ft) for selected stabilization and command augmentation systems and flight director combinations. Precise landings at low touchdown sink rates were achieved with a gentle flare maneuver. S.F.

N81-11045# Range Commanders Council, White Sands Missile Range, N. Mex. Range Safety Group.
FLIGHT TERMINATION RECEIVER/DECODERS DESIGN, PERFORMANCE AND CERTIFICATION Final Report
1980 20 p Supersedes RSG-313-72
(AD-A089746; RSG-313-80; RSG-313-72) Avail: NTIS HC A02/MF A01 CSCL 16/1

This document contains design, performance, and certification test requirements for range safety flight termination system command destruct receiver/decoders. It replaces Range Commanders Council (RCC) Range Safety Group (RSG) Document 313-72. Flight termination is an emergency action taken by Range Safety for the protection of life and property when a vehicle violates established safety criteria. This action circumvents the vehicle's normal control modes and ends its power and/or controlled flight. Flight termination procedures may include any one or a combination of the following: (a) Complete vehicle destruction by explosive means; (b) Aerodynamic disruption of the flight mechanism; (c) Deployment of high drag devices; (d) Fuel cut-off to the combustion chambers of ignited motors; (e) Inhibit ignition of unburned motors; and (f) Other special actions dictated by the vehicle configuration or special problems. These actions may be activated by manual, computerized and/or automated modes. GRA

N81-11046# Purdue Univ., Lafayette, Ind. School of Aeronautics and Astronautics.
MULTIVARIABLE CLOSED-LOOP ANALYSIS AND FLIGHT CONTROL SYNTHESIS FOR AIR-TO-AIR TRACKING Final Report, 1 Jan. - 31 Dec. 1979
David K. Schmidt 18 Jun. 1980 105 p refs
(Grant AF-AFOSR-0042-79; AF Proj. 2313)
(AD-A090050; AFOSR-80-0961TR) Avail: NTIS HC A06/MF A01 CSCL 05/8

A synthesis method based on optimal control techniques, closed-loop task-oriented design objectives, and an optimal control model of the human pilot was applied to augment the system dynamics in the air-to-air tracking task. Single and multi-axis analyses were performed. Single axis results, obtained for longitudinal pitch tracking with different sets of active sight display dynamics, indicate the optimum system dynamics were affected by numerator (or display) dynamics. Improved tracking performance was predicted, and the trends in augmented system dynamics (eigenvalues) were shown to agree with previous results. Moving-base simulation results obtained for a highly-banked flight condition were also used to establish a new multi-axis pilot model. This model is considered suitable for simultaneous control of the dynamically interacting longitudinal and lateral-directional axes of the vehicle/display system. The system augmentation, based on this model, again was predicted to significantly improve performance. The trends in system eigenvalues for various augmentation levels showed good agreement with the above longitudinal results. However, the lateral-directional axis was found to be much more important, and significant modification of the dynamics were predicted to lead to system improvements. GRA

N81-11047# Systems Research Labs., Inc., Dayton, Ohio.
A MULTIVARIATE APPROACH TO HANDLING QUALITIES RATING SCALE DEVELOPMENT Final Report, 1 Jun. - 30 Sep. 1979
Ralph H. Smith and Warren S. Torgenson Jan. 1980 186 p refs
(Contract F49620-79-C-0158; AF Proj. 2313)
(AD-A089825; AFOSR-80-0876TR) Avail: NTIS HC A09/MF A01 CSCL 01/3

Recent advances in aircraft handling qualities indicate the possibility that a small number of physical dimensions can be used for handling qualities quantification. Several candidate metrics for handling qualities now exist which form a portion of the set required. An exploratory study was conducted to evaluate the use of multivariate analysis techniques for identification of the necessary physical dimensions of handling qualities. It is concluded that the Cooper-Harper scale can be considered a direction in the space defined by the first few principal components of the experimental variance-covariance matrix. A simulation experiment is proposed which should permit development of a set of nonadjectival rating scales which will complement the Cooper-Harper scale, reduce the variability of pilot rating data, and better support the flight test identification of handling deficiencies. GRA

N81-11269# Saab-Scania, Linkoping (Sweden). Aerospace Div.
COMPUTER BASED IN-FLIGHT MONITORING
Kjell Folkesson *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 23 p (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

N81-11274*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
FLIGHT EXPERIENCE WITH FLIGHT CONTROL REDUNDANCY MANAGEMENT
Kenneth J. Szalai, Richard R. Larson, and Richard D. Glover *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 27 p refs (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01 CSCL 01C

N81-11275# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. for Flight System Dynamics.
ROBUST CONTROL SYSTEM DESIGN
J. Ackermann *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 14 p refs (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N81-11048# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CRYOGENIC WIND TUNNELS
Jul. 1980 271 p refs Lecture series held in Rhode-Saint-Genese, Belgium, 19-23 May 1980 and in Hampton, Va., 27-30 May 1980
(AGARD-LS-111; ISBN-92-835-1360-6) Avail: NTIS HC A12/MF A01

The advantages of the cryogenic wind tunnel lie mainly in the practical attainment of full scale values of Reynolds number. Up to date information on the aerodynamic and mechanical design of continuous and intermittent cryogenic wind tunnels and their models, and on techniques for controlling test parameters is provided. Design information includes properties of materials, the storage and handling of cryogenic liquids, insulation systems for pipelines and tunnel circuits, and safety requirements. Solutions are included for the special requirements of instrumentation systems for plant, tunnel and model. The physical processes are described which determine the lower limits of operating temperature. For individual titles, see N81-11049 through N81-11067.

N81-11049# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
THE PRINCIPLES AND APPLICATIONS OF CRYOGENIC WIND TUNNELS
M. J. Goodyer *In* AGARD Cryogenic Wind Tunnels Jul. 1980 6 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

The background to the emergencies of the cryogenic wind tunnel is described and its advantages compared with other means for raising the values of test Reynolds number to full scale are discussed. The basic aero and thermodynamics of wind tunnel testing is introduced and the advantages of low temperature in low speed and in transonic testing are quantified. Attention is drawn to secondary advantages unique to this tunnel, and to the potentials of unconventional test gases. Descriptions of current types and applications of cyrogenic wind tunnels are included.
R.K.G.

N81-11050# Southampton Univ. (England). Inst. of Cryogenics.
CRYOGENIC ENGINEERING 1
R. G. Scurlock *In* AGARD Cryogenic Wind Tunnels Jul. 1980 9 p (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

The concept of a liquid boiling under 1 atm pressure at a temperature which is well below the lowest naturally occurring temperatures (i.e. below -50 C or 223K) and below the region normally associated with refrigeration engineering is introduced. Cryogenic wind tunnels require the use of cryogenic liquids, such as liquid nitrogen, in quantities ranging from 10 to 100 tonnes. The scale of use also means that safety precautions and safe operating procedures are to be rigorously maintained; much more so than with laboratory size quantities. Cryogenic liquids are energy-intensive to produce and expensive to use. Ice or snow covered patches on insulation, and white plumes of boiloff vapor, are specific indications of poor housekeeping techniques. Apart from these considerations, cryogenic liquids are very easy to use and the technology for storage, for transport by road, rail or sea (or air), and for handling is well developed. R.K.C.

N81-11051# Southampton Univ. (England). Inst. of Cryogenics.
CRYOGENIC ENGINEERING 2
R. G. Scurlock *In* AGARD Cryogenic Wind Tunnels Jul. 1980 7 p (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

Thermal properties of commercial materials are discussed. Instrumentation at low temperature which includes thermometry, pressure, and fluid flow is described. Conditions to avoid two phase flow are mentioned. R.K.G.

N81-11052# Southampton Univ. (England). Inst. of Cryogenics.
PROPERTIES OF MATERIALS: THE PHYSICAL PROPERTIES OF METALS AND NON-METALS
D. A. Wigley *In* AGARD Cryogenic Wind Tunnels Jul. 1980 10 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

The requirements of a cryogenic wind tunnel project are considered in the context of the technology already developed for the storage and handling of large quantities of cryogenic fluids. Heat capacities are discussed in relation to the quantity of fluid evaporated during cooling and also to the thermal response time of the tunnel. The thermal conductivities of metals and nonmetals are considered, particularly in the context of good conductors which are used to reduce thermal gradients, and poor conductors which are used to reduce thermal gradients, and poor conductors which can be used as insulants to minimize the heat flowing into the cold regions. Electrical conduetivity is discussed particularly with reference to the high resistivity alloys used in strain gauges and heaters, together with reference to thermoelectric effects and possible use of superconducting magnets. The thermal contraction of materials at low temperatures and the more common problems caused by differential contraction are discussed. Some design data is included in the text and references are given to the major data compilations. R.K.G.

N81-11053*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REAL-GAS EFFECTS 1: SIMULATION OF IDEAL GAS FLOW BY CRYOGENIC NITROGEN AND OTHER SELECTED GASES
Robert M. Hall *In* AGARD Cryogenic Wind Tunnels Jul. 1980 16 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01 CSCL 14B

The thermodynamic properties of nitrogen gas do not thermodynamically approximate an ideal, diatomic gas at cryogenic temperatures. Choice of a suitable equation of state to model its behavior is discussed and the equation of Beattie and Bridgeman is selected as best meeting the needs for cryogenic wind tunnel use. The real gas behavior of nitrogen gas is compared to an ideal, diatomic gas for the following flow processes: isentropic expansion; normal shocks; boundary layers; and shock wave boundary layer interactions. The only differences in predicted pressure ratio between nitrogen and an ideal gas that may limit the minimum operating temperatures of transonic cryogenic wind tunnels seem to occur at total pressures approaching 9 atmospheres and total temperatures 10 K below the corresponding saturation temperature, where the differences approach 1 percent for both isentropic expansions and normal shocks. Several alternative cryogenic test gases - air, helium, and hydrogen - are also analyzed. Differences in air from an ideal, diatomic gas are similar in magnitude to those of nitrogen. Differences for helium and hydrogen are over an order of magnitude greater than those for nitrogen or air. Helium and hydrogen do not approximate the compressible flow of an ideal, diatomic gas.
R.K.G.

N81-11054# Southampton Univ. (England). Inst. of Cryogenics.
PROPERTIES OF MATERIALS: THE EFFECT OF LOW TEMPERATURES ON THE STRENGTH AND TOUGHNESS OF MATERIALS
D. A. Wigley *In* AGARD Cryogenic Wind Tunnels Jul. 1980 24 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

The factors which influence the stiffness, strength and toughness of materials at low temperatures are considered. The relative sensitivity of each major parameter to changes in the structure and purity of a material is discussed in the context of the degree of reliability that can be placed on data taken from the literature. Yield and plastic deformation are highly structure sensitive and the effect of crystal structure is discussed at length. Design data is given for copper, nickel and aluminum-based alloys,

which together with Invar and the autenite stainless steels all have face-centred cubic structures. The problems caused by the ductile-brittle transition in metals with body centered cubic structures are outlined, and the use of low alloy and nickel steels in the temperature range 300K to 70K is discussed. Fracture toughness is considered in the context of its use in promoting fail safe design techniques under steady and alternating loads, and other relevant low temperature failure modes are also discussed. R.K.G.

N81-11055*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REAL GAS EFFECTS 2: INFLUENCE OF CONDENSATION ON MINIMUM OPERATING TEMPERATURES OF CRYOGENIC WIND TUNNELS
Robert M. Hall *In* AGARD Cryogenic Wind Tunnels Jul. 1980 21 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01 CSCL 14B

Condensation effects are responsible for the minimum operating temperatures of cryogenic wind tunnels at total pressures up to about 9 atmospheres. The two primary modes of condensation homogeneous nucleation and heterogeneous nucleation and the conditions with which either may limit minimum operating temperatures are reveiwed. Previous hypersonic and supersonic condensation data are reviewed as are data taken in the nitrogen gas, Langley 0.3 Meter Transonic Cryogenic Tunnel. Analysis of data in the 0.3 m tunnel suggests that the onset of homogenous nucleation may be approximated by an analysis by sivier and that the onset of heterogeneous nucleation is only apparent just below free stream saturation. Extension of the results from the 0.3 m tunnel to other nitrogen gas cryogenic tunnels is discussed and is shown to depend on length scales, purity of the liquid nitrogen injected for cooling, number of particulates in the flow, and the extent to which the injected liquid nitrogen is evaporated. R.K.G.

N81-11056# Southampton Univ. (England).
CRYOGENIC ENGINEERING 3
R. G. Scurlock *In* AGARD Cryogenic Wind Tunnels Jul. 1980 6 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

Handling and transfer of LIN are discussed. Cooldown and thermal cycling problems are described. Safety factors including asphyxia, cold burns, explosion and fire hazards are discussed. R.K.G.

N81-11057*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MODEL DESIGN AND INSTRUMENTATION EXPERIENCES WITH CONTINUOUS-FLOW CRYOGENIC TUNNELS
Robert A. Kilgore *In* AGARD Cryogenic Wind Tunnels Jul. 1980 22 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01 CSCL 14B

The development of wind tunnels that can be operated at cryogenic temperatures has placed several new demands on the ability to build and instrument wind tunnel models. The experiences at the NASA Langley Research Center relative to the design and instrumentation of models for continuous flow cryogenic wind tunnels are reviewed. R.K.G.

N81-11058# Douglas Aircraft Co., Inc., Long Beach, Calif. Aerodynamics Subdiv.
MODEL DESIGN AND INSTRUMENTATION FOR INTERMITTENT CRYOGENIC WIND TUNNELS
J. D. Cadwell *In* AGARD Cryogenic Wind Tunnels Jul. 1980 8 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

The design and instrumentation of a model for an intermittent cryogenic wind tunnel is discussed. The model requirements including tolerances and data accuracy are noted. The mechanical design of the wing, the considerations for material to be used, and the instrumentation that is to be installed in the wing are discussed. The design of the fuselage center section, the six component balance installation with heaters, and the heater for the balance-to-sting adapter is reviewed. The design and the aft fuselage and empennage, and the fuselage nose including the instrumentation package to be housed in the fuselage nose compartment is shown. The model conditioning that is required to obtain acceptable data, prevent frost buildup on the model after it is cooled, and reheating the model to make model configuration changes is also discussed. R.K.G.

N81-11059*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SELECTION AND APPLICATION OF INSTRUMENTATION FOR CALIBRATION AND CONTROL OF A CONTINUOUS-FLOW CRYOGENIC TUNNEL
Robert A. Kilgore *In* AGARD Cryogenic Wind Tunnels Jul. 1980 10 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01 CSCL 14B

Selection and application of calibration and control instrumentation influenced by the extremes in the temperature environment to be found in cryogenic tunnels are described. The instrumentation and data acquisition system used in the Langley 0.3 m transonic tunnel are described along with typical calibration data obtained in a 20 by 60 cm two dimensional test section. S.F.

N81-11060# Douglas Aircraft Co., Inc., Long Beach, Calif. Aerodynamics Subdiv.
CALIBRATION OF A BLOWDOWN-TO-ATMOSPHERE CRYOGENIC WIND TUNNEL
J. D. Cadwell *In* AGARD Cryogenic Wind Tunnels Jul. 1980 9 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

Calibration of short duration cryogenic wind tunnels pose difficulties and requirements beyond those already present in the calibration either of conventional short run time facilities or of cryogenic continuous tunnels. The requirements and instrumentation for calibration of a transonic blowdown to atmosphere cryogenic wind tunnel are described, with emphasis on those aspects differing from the calibration of similar non-cryogenic tunnels. Reference is made of the literature for detailed descriptions of conventional calibration practices which remain applicable for cryogenic blowdown tunnels. Author

N81-11061# Centre d'Etudes et de Recherches, Toulouse (France). Aerothermodynamics Dept.
THE DEVELOPMENT OF A CRYOGENIC WIND TUNNEL DRIVEN BY INDUCTION: FLOW CONTROL AND INSTRUMENTATION STUDIES IN A PILOT FACILITY AT ONERA/CERT
R. Michel *In* AGARD Cryogenic Wind Tunnels Jul. 1980 12 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01

A solution for an intermittent cryogenic wind tunnel, using pressure air as a driving gas and nitrogen as cooler, is studied. The cryogenization of the transonic injector driven tunnel is presented. Experimental studies were carried out on a pilot unit, a pressurized return circuit wind tunnel with a 10 by 10 cm test section. Problems related to the control and optimization of short cryogenic runs are summarized. S.F.

N81-11062*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPERIENCE IN THE CONTROL OF A CONTINUOUS FLOW CYROGENIC TUNNEL
Robert A. Kilgore *In* AGARD Cryogenic Wind Tunnels Jul. 1980 15 p refs (For primary document see N81-11048 02-09)
Avail: NTIS HC A12/MF A01 CSCL 14B

The concept of using liquid nitrogen to cool the test gas of a wind tunnel to cryogenic temperatures lead to the achievement of very high Reynolds number flows in relatively small transonic tunnels. The economical operation of liquid nitrogen cooled cryogenic tunnels is critically dependent on fast and accurate control of the tunnel variables. The control problem of a continuous flow fan driven cryogenic tunnel was addressed, first by developing a lumped multivariable mathematical model of a tunnel and validating the model by reconciling the responses of the Langley 0.3 m transonic cryogenic tunnel to the responses of the mathematical model on a simulator. Finally, the development of laws for the closed loop control of the tunnel pressure and temperature and the successful implementation of a control system for the 0.3 m transonic cryogenic tunnel based on these laws are presented. Author

N81-11063# Douglas Aircraft Co., Inc., Long Beach, Calif. Aerodynamics Subdiv.

THE CONTROL OF PRESSURE, TEMPERATURE AND MACH NUMBER IN A BLOWDOWN-TO-ATMOSPHERE CRYOGENIC WIND TUNNEL

J. D. Cadwell *In* AGARD Cryogenic Wind Tunnels Jul. 1980 8 p ref (For primary document see N81-11048 02-09)

Avail: NTIS HC A12/MF A01

The control system that used in a four foot blowdown wind tunnel prior to the modification of the facility to a cryogenic operation is reviewed. The control requirements for a cryogenic blowdown tunnel and the Mach and Reynolds number controls are discussed. The proposed method to be used to control the temperature in the cryogenic tunnel is shown. The start of a blow sequence in a cryogenic blowdown tunnel and the detrimental effect that it has on a pre cooled model is considered. A transient protection system, to be evaluated in a one foot pilot tunnel that will shield the model during the start of a run is shown. The conventional method of measuring model attitude by correcting the pod angle for sting and balance deflections is shown to be inadequate in a cryogenic blowdown tunnel and alternate methods that can be used are discussed. Author

N81-11064# National Aerospace Lab., Amsterdam (Netherlands).

THE EUROPEAN TRANSONIC WIND TUNNEL ETW

J. P. Hartzuiker and R. J. North *In* AGARD Cryogenic Wind Tunnels Jul. 1980 17 p refs (For primary document see N81-11048 02-09)

Avail: NTIS HC A12/MF A01

A high Reynolds number transonic tunnel is described on the basis of preliminary design results. The construction of a cryogenic pilot tunnel and supporting programs on model design and instrumentation are discussed. S.F.

N81-11065*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CHARACTERISTICS AND STATUS OF THE US NATIONAL TRANSONIC FACILITY

William B. Igoe *In* AGARD Cryogenic Wind Tunnels Jul. 1980 11 p refs (For primary document see N81-11048 02-09)

Avail: NTIS HC A12/MF A01 CSCL 14B

A major application of the cryogenic wind tunnel concept is discussed. A closed return fan driven circuit with a 2.5 meter square slotted test section, pressurized up to 8.85 atmospheres, and providing chord Reynolds numbers of 120 million based on a chord of 0.25 meter at transonic speeds using cold nitrogen as the test gas is described. S.F.

N81-11066# Douglas Aircraft Co., Inc., Long Beach, Calif. Aerodynamics Subdiv.

THE DOUGLAS AIRCRAFT COMPANY FOUR FOOT CRYOGENIC WIND TUNNEL Progress Report

J. D. Cadwell *In* AGARD Cryogenic Wind Tunnels Jul. 1980 7 p (For primary document see N81-11048 02-09)

Avail: NTIS HC A12/MF A01

The modification of a four foot trisonic wind tunnel to operate at cryogenic temperatures is described. Development of the instrumentation and test techniques are also reviewed, including model design, fabrication, inspection techniques, force and moment, pressure instrumentation, boundary layer transition detection methods, model angle of attack measurement, model precooling evaluation, and selection of materials for the verification model. The current schedule of the tunnel checkout and calibration, and the development of instrumentation and test techniques is discussed as well as the verification test which will provide the data necessary to evaluate the performance of the modified four foot tunnel at cryogenic temperatures for the Mach number range from 0.5 to 1.0. S.F.

N81-11067# Centre d'Etudes et de Recherches, Toulouse (France). Aerothermodynamics Dept.

A CRYOGENIC TRANSONIC INTERMITTENT TUNNEL PROJECT: THE INDUCED FLOW CRYOGENIC WIND TUNNEL T2 AT ONERA/CERT

R. Michel *In* AGARD Cryogenic Wind Tunnels Jul. 1980 9 p ref (For primary document see N81-11048 02-09)

Avail: NTIS HC A12/MF A01

A cryogenic intermittent tunnel, which use high pressure air as a driving gas and nitrogen as a cooler, is described. A description of its main characteristics at ambient operating temperature is given. Various aspects of its transformation for a low operating temperature are analyzed: modifications of the circuit, thermal insulation technique, liquid nitrogen injection, regulation systems, cryogenic operating mode, and expected performances. S.F.

N81-11978*# Colorado Univ., Boulder.

DEVELOPMENT OF A FACILITY FOR LARGE-SCALE TESTING OF MULTISTORY BUILDINGS

Daniel P. Abrams *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 16 p refs (For primary document see N81-11977 02-99)

Avail: NTIS HC A99/MF A01 CSCL 14B

N81-12009*# Jackson State Univ., Miss.

PAYLOAD MAINTENANCE COST MODEL FOR THE SPACE TELESCOPE

William L. White *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 15 p refs (For primary document see N81-11977 02-99)

Avail: NTIS HC A99/MF A01 CSCL 03A

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see 91 Lunar and Planetary Exploration.

N81-11068*# Aerospace Corp., El Segundo, Calif. Advanced Systems Technology Div.

SWARMS: OPTIMUM AGGREGATIONS OF SPACECRAFT

Harris L. Mayer 29 Feb. 1980 233 p refs

(Contract NASw-3160)

(NASA-CR-163700; ATR-80(7734)-1) Avail: NTIS HC A11/MF A01 CSCL 22A

Swarms are aggregations of spacecraft or elements of a space system which are cooperative in function, but physically isolated or only loosely connected. For some missions the swarm configuration may be optimum compared to a group of completely independent spacecraft or a complex rigidly integrated spacecraft or space platform. General features of swarms are induced by considering an ensemble of 26 swarms, examples ranging from Earth centered swarms for commercial application to swarms for exploring minor planets. A concept for a low altitude swarm as a substitute for a space platform is proposed and a preliminary design studied. The salient design feature is the web of tethers holding the 30 km swarm in a rigid two dimensional array in the orbital plane. A mathematical discussion and tutorial in tether technology and in some aspects of the distribution of services (mass, energy, and information to swarm elements) are included. S.F.

N81-11069*# TRW Systems Group, Houston, Tex. Systems Engineering and Analysis Dept.

DEVELOPMENT AND IMPLEMENTATION OF SHUTTLE/IUS PROXIMITY OPERATIONS FLIGHT DESIGN SOFTWARE Final Report

S. W. Wilson 30 Sep. 1980 16 p refs

(Contract NAS9-14723)

(NASA-CR-160879; Rept-28415-H012-R0-00) Avail: NTIS HC A02/MF A01 CSCL 22A

The High Fidelity Relative Motion Program (HFRMP), a trajectory/attitude numerical integration program, was developed and implemented on the MPAD HP-9825A desk top computer systems. A solar and a lunar ephemeris is included in the HFRMP along with models of the oblate Earth, a rotating atmosphere, the orbiter's OMS/RCS/DAP system, orbiter vents, rotor dynamics, and upper stage propulsion systems. Although designed primarily for the analysis of proximity operations, it is useful in other areas such as attitude/stability analysis, propulsive consumables estimation, and trajector perturbation studies. An unique identification was assigned to each of the various configurations of the HFRMP that were developed to test new techniques and algorithms are briefly described. These include the HFRMP Versions 03H, 03M, 03T, 03U, and 05D. Development

of orbiter/upper stage separation techniques including flight design support for the TDRS-A and Galileo deployment flights and design of standard maneuver sequences is discussed. Also, the development and implementation of the Euler angle conversion program is briefly addressed. J.M.S.

N81-11993*# Fisk Univ., Nashville, Tenn. Dept. of Physics.
CALCULATIONS AND MEASUREMENTS IN SUPPORT OF THE TRIGLYCINE SULFATE ZERO GRAVITY GROWTH EXPERIMENT
John M. Springer *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 19 p *refs (For primary document see N81-11977 02-99)*
Avail: NTIS HC A99/MF A01 CSCL 07D

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N81-11070*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FIFTH ANNUAL FLIGHT MECHANICS/ESTIMATION THEORY SYMPOSIUM
Jerome Teles, ed. Oct. 1980 464 p refs Symp. held in Greenbelt, Md., 21-22 Oct. 1980
(NASA-CP-2152) Avail: NTIS HC A20/MF A01 CSCL 22A

Various aspects of astrodynamics are considered including *orbit calculations and trajectory determination. Other topics dealing* with remote sensing systems, satellite navigation, and attitude control are included. For individual titles, see N81-11071 through *N81-11088.*

N81-11071*# Systems and Applied Sciences Corp., Riverdale, Md.
FEASIBILITY STUDY OF USING A TWO-PLATE MODEL TO APPROXIMATE THE TDRSS SOLAR PRESSURE EFFECTS
F. K. Chan *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 15 p refs *(For primary document see N81-11070 02-13)*
(Contract NAS5-25139)
Avail: NTIS HC A20/MF A01 CSCL 22A

An investigation was performed to determine the feasibility of using a two plate model to approximate the Tracking and Data Relay Satellite (TDRS) in orbit propagation, taking into *account the effects of solar radiation pressure. The two plate* model comprises one plate which always points to the Earth, and the other which is hinged to an axis normal to the orbital plane and is always rotated so that its normal makes a minimum angle with the direction of the sun. The results indicate that it is sufficient to take three parameters, the areas of the two plates and the reflectivity of the Earth pointing plate, to achieve an accuracy of one meter during a 24 hour orbit propagation.
E.D.K.

N81-11072*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMPROVED CHEBYSHEV SERIES EPHEMERIS GENERATION CAPABILITY OF GTDS
S. Y. Liu (Computer Sciences Corp., El Segundo, Calif.), J. Rogers (Computer Sciences Corp., El Segundo, Calif.), and J. J. Jacintho *In its* Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 46 p refs (For primary document see N81-11070 02-13)
(Contract NAS5-24300)
Avail: NTIS HC A20/MF A01 CSCL 22A

An improved implementation of the Chebyshev ephemeris generation capability in the operational version of the Goddard *Trajectory Determination System (GTDS) is described. Preliminary* results of an evaluation of this orbit propagation method for three satellites of widely different orbit eccentricities are also discussed in terms of accuracy and computing efficiency with respect to the Cowell integration method. An empirical formula *is deduced for determining an optimal fitting span which would* give reasonable accuracy in the ephemeris with a reasonable consumption of computing resources. E.D.K.

N81-11073*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ECONOMICAL SEMI-ANALYTICAL ORBIT THEORY FOR RETARDED SATELLITE MOTION ABOUT AN OBLATE PLANET
Robert A. Gordon *In its* Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 14 p refs (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

Brouwer and Brouwer-Lyddanes' use of the Von Zeipel-Delaunay method is employed to develop an efficient analytical orbit theory suitable for microcomputers. A succinctly simple *pseudo-phenomenologically conceptualized algorithm is introduced* which accurately and economically synthesizes modeling of drag effects. The method epitomizes and manifests effortless efficient *computer mechanization. Simulated trajectory data is employed* to illustrate the theory's ability to accurately accommodate oblateness and drag effects for *microcomputer ground based or* onboard predicted orbital representation. Real tracking data is used to demonstrate that the theory's orbit determination and *orbit prediction capabilities are favorably adaptable to and are* comparable with results obtained utilizing complex definitive Cowell method solutions on satellites experiencing significant *drag effects.* E.D.K.

N81-11074*# Massachusetts Inst. of Tech., Cambridge.
SEMIANNALYTICAL SATELLITE THEORY AND SEQUENTIAL ESTIMATION
Stephen P. Taylor and Paul J. Cefola *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 18 p refs Prepared in cooperation with *Charles Stark Draper Lab., Inc. (For primary document see* N81-11070 02-13)
(Contract F04701-79-C-0062)
Avail: NTIS HC A20/MF A01 CSCL 22A

Kalman filtering techniques are combined with a semianalytical orbit generator to develop a sequential orbit determination *algorithm. The algorithm is investigated for computational* efficiency, accuracy, and radius of convergence by comparison with truth ephemerides and a Cowell special perturbations filters *(GTDS). Test cases relevant to satellite navigation are exam-*ined. Author

N81-11075*# Business and Technological Systems, Inc., Bowie, Md.
***ESTIMATION OF KALMAN FILTER MODEL PARAMETERS* FROM AN ENSEMBLE OF TESTS**
B. P. Gibbs, D. R. Haley, W. Levine, D. W. Porter, and C. J. Vahlberg *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 29 p refs (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

A methodology for estimating initial mean and covariance parameters in a Kalman filter model from an ensemble of nonidentical tests is presented. In addition, the problem of estimating time constants and process noise levels is addressed. *Practical problems such as developing and validating inertial* instrument error models from laboratory test data or developing error models of individual phases of a test are generally considered. M.G.

N81-11076*# Computer Sciences Corp., El Segundo, Calif.
ANALYSIS OF ESTIMATION ALGORITHMS FOR AUTONOMOUS NAVIGATION WITH TDRSS DATA
J. Dunham, A. Long, P. Gural, K. Preiss, and H. Sielski *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 52 p *refs (For* primary document see N81-11070 02-13)
(Contract NAS5-24300)
Avail: NTIS HC A20/MF A01 CSCL 22A

Estimation techniques for onboard orbit determination using Tracking and Data Relay Satellite System (TDRSS) data are investigated. The two user satellite orbits studied are similar to Landsat-D (near-circular, 700 kilometers altitude, near-polar inclination). The following estimation algorithms are identified as candidates for use in autonomous navigation: (1) the extended Kalman filter with process noise, (2) the EKF with consider parameters, (3) the sequential Kalman filter with consider

parameters, and (4) the batch least-squares differential correction technique. The candidate estimators are evaluated with respect to their performance with both baseline and worst TDRSS measurement errors and tracking configurations. M.G.

N81-11077*# Aerospace Corp., Los Angeles, Calif.
AUTONOMOUS NAVIGATION ACCURACY USING SIMULATED HORIZON SENSOR AND SUN SENSOR OBSERVATIONS
G. E. Pease and H. T. Hendrickson *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 9 p refs (For primary document see N81-11070 02-13)
(Contract F04701-79-C-0080)
Avail: NTIS HC A20/MF A01 CSCL 22A

A relatively simple autonomous system which would use horizon crossing indicators, a sun sensor, a quartz oscillator, and a microprogrammed computer is discussed. The sensor combination is required only to effectively measure the angle between the centers of the Earth and the Sun. Simulations for a particular orbit indicate that 2 km r.m.s. orbit determination uncertainties may be expected from a system with 0.06 deg measurement uncertainty. A key finding is that knowledge of the satellite orbit plane orientation can be maintained to this level because of the annual motion of the Sun and the predictable effects of Earth oblateness. The basic system described can be updated periodically by transits of the Moon through the IR horizon crossing indicator fields of view. M.G.

N81-11078*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN EVALUATION OF GALILEO-VIKING DIFFERENCED RANGE IN GALILEO-MARS FLYBY NAVIGATION
F. B. Winn, E. W. Walsh, M. P. Ananda, and F. T. Nicholson *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 28 p ref (For primary document see N81-11070 02-13)
(Contract NAS7-100)
Avail: NTIS HC A20/MF A01 CSCL 22A

A summary and evaluation of the Galileo-Mars flyby navigation techniques is presented. The navigational requirements of Galileo as it swings by Mars are going to be met with interferometric angular measurements (VLBI) and range and range-rate measurements. Like VLBI, dual spacecraft differenced range is less sensitive to Mars ephemeris errors and tracking station location errors than conventional range and Doppler. Similarly, differenced range provides angular information about the separation between the Mars Viking Lander I and the Galileo spacecraft. In covariance studies, dual spacecraft range coupled with conventional range and Doppler is shown to estimate the Galileo-Mars flyby distance to better than 10 km which is comparable to the VLBI performance. For the Galileo-Mars flyby, dual spacecraft differenced range promise to be an excellent backup to VLBI if the Mars Viking Lander remains operational. M.G.

N81-11079*# Computer Sciences Corp., Silver Spring, Md.
AN ANALYSIS OF GDOP IN GLOBAL POSITIONING SYSTEM NAVIGATION
Bertrand T. Fang *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 14 p refs (For primary document see N81-11070 02-13)
(Contract NAS5-24300)
Avail: NTIS HC A20/MF A01 CSCL 22A

The accuracy of user navigation fix based on the NAVSTAR global positioning system is described. The trace of this matrix serves as a convenient navigation performance index and the square root of the trace is called geometric dilution of precision (GDOP). Certain theoretical results concerning the general properties of the navigation performance are derived. An efficient algorithm for the computation of GDOP is given. Applications of the results are illustrated by numerical examples. R.C.T.

N81-11080*# Systems and Applied Sciences Corp., Riverdale, Md.
A QUADRILATERALIZED SPHERICAL CUBE EARTH DATA BASE
F. K. Chan *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 25 p ref (For primary document see N81-11070 02-13)
(Contract N66314-74-C-1340)
Avail: NTIS HC A20/MF A01 CSCL 22A

A quadrilateralized spherical cube was constructed to form the basis for the rapid storage and retrieval of high resolution data obtained of the Earth's surface. The structure of this data base was derived from a spherical cube, which was obtained by radially projecting a cube onto its circumscribing sphere. An appropriate set of curvilinear coordinates were chosen such that the resolution cells on the spherical cube were of equal area and were also of essentially the same shape. The main properties of the Earth data base were that the indexing scheme was binary and telescopic in nature, the resolution cells were strung together in a two dimensional manner, the cell addresses were easily computed, and the conversion from geographic to data base coordinates was comparatively simple. It was concluded that this data base structure was perhaps the most viable one for handling remotely sensed data obtained by satellites. R.C.T.

N81-11081*# Martin Marietta Corp., Denver, Colo. Advanced Automation Technology.
ADAPTIVE GUIDANCE AND CONTROL FOR FUTURE REMOTE SENSING SYSTEMS
James W. Lowrie and John E. Myers (Metropolitan State Coll., Denver, Colo.) *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 17 p refs (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

A unique approach to onboard processing was developed that is capable of acquiring high quality image data for users in near real time. The approach is divided into two steps: the development of an onboard cloud detection system; and the development of a landmark tracker. The results of these two developments are outlined and the requirements of an operational guidance and control system capable of providing continuous estimation of the sensor boresight position are summarized. R.C.T.

N81-11082*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DOUBLY-PERIODIC ORBITS IN THE SUN-EARTH-MOON SYSTEM
R. Farohar, D. Muhonen, and D. Dunham (Computer Sciences Corp., El Segundo, Calif.) *In its* Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 19 p (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

A series of periodic orbits in the Earth-Moon circular restricted problem of three bodies was found which is ideally suited for exploring the Earth's geomagnetic tail. The mean apsidal motion of the basic highly elliptical Earth orbit was maintained at about one degree per day by a sequence of lunar swingbys, keeping the apogees in the anti-Sun direction. The orbits were periodic in reference frames rotating at both lunar and solar rates. Apogee distances were alternately raised and lowered by the lunar swingby maneuvers. Several categories of these Sun-synchronous double lunar swingby orbits were identified. The strength and flexibility of this trajectory concept was demonstrated with real world simulations. R.C.T.

N81-11083*# Computer Sciences Corp., Silver Spring, Md.
ATTITUDE GROUND SUPPORT SYSTEM FOR THE SOLAR MAXIMUM MISSION SPACECRAFT
G. Nair *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 18 p refs (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

The SMM attitude ground support system (AGSS) supports the acquisition of spacecraft roll attitude reference, performs the in-flight calibration of the attitude sensor complement, supports onboard control autonomy via onboard computer data base updates, and monitors onboard computer (OBC) performance. Initial roll attitude acquisition is accomplished by obtaining a coarse 3 axis attitude estimate from magnetometer and Sun sensor data and subsequently refining it by processing data from the fixed head star trackers. In-flight calibration of the attitude sensor complement is achieved by processing data from a series of slew maneuvers designed to maximize the observability and

accuracy of the appropriate alignments and biases. To ensure autonomy of spacecraft operation, the AGSS selects guide stars and computes sensor occultation information for uplink to the OBC. The onboard attitude control performance is monitored on the ground through periodic attitude determination and processing of OBC data in downlink telemetry. In general, the control performance has met mission requirements. However, software and hardware problems have resulted in sporadic attitude reference losses. Author

N81-11084*# Computer Sciences Corp., Silver Spring, Md.
IN-FLIGHT CALIBRATION AND PERFORMANCE EVALUATION OF THE FIXED HEAD STAR TRACKERS FOR THE SOLAR MAXIMUM MISSION
Richard H. Thompson and Pascal J. Gambardella *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 16 p refs (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

The Solar Maximum Mission (SMM) spacecraft provides an excellent opportunity for evaluating attitude determination accuracies achievable with tracking instruments such as fixed head star trackers (FHSTs). As a part of its payload, SMM carries a highly accurate fine pointing Sun sensor (FPSS). The EPSS provides an independent check of the pitch and yaw parameters computed from observations of stars in the FHST field of view. A method to determine the alignment of the FHSTs relative to the FPSS using spacecraft data is applied. Two methods that were used to determine distortions in the 8 degree by 8 degree field of view of the FHSTs using spacecraft data are also presented. The attitude determination accuracy performance of the in flight calibrated FHSTs is evaluated. A.R.H.

N81-11085*# Computer Sciences Corp., Silver Spring, Md.
IN-FLIGHT CALIBRATION OF THE FINE POINTING SUN SENSOR ON THE SOLAR MAXIMUM MISSION
Pascal J. Gambardella and Richard H. Thompson *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 17 p refs (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

The attitude control objectives of solar maximum mission are to point the boresight of the payload fine pointing sun sensor (FPSS) to any point within 30 arc-minutes of the Sun's center with an accuracy of 5 arc-seconds (3 sigma, pitch and yaw) and a jitter of less than 3 arc-seconds (3 sigma). To meet these stringent accuracy requirements, a procedure was developed for in-flight calibration of the FPSS. The spacecraft was maneuvered using FPSS offset commands to position the Sun at different points within the FPSS field of view. The coefficients of the FPSS digital to analog nonlinear transfer function were determined by minimizing the residuals between the pitch and yaw angles computed from the FPSS measurements and the corresponding reference angles obtained from inertial reference unit measurements. The actual in-flight calibration and the calibration algorithm are discussed. A.R.H.

N81-11086*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGSAT ATTITUDE DYNAMICS AND CONTROL: SOME OBSERVATIONS AND EXPLANATIONS
Thomas H. Stengle *In its* Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 9 p refs (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

Before its reentry 7 months after launch, Magsat transmitted an abundance of valuable data for mapping the Earth's magnetic field. As an added benefit, a wealth of attitude data for study by spacecraft dynamicists was also collected. Because of its unique configuration, Magsat presented new control problems. With its aerodynamic trim boom, attitude control was given an added dimension. Minimization of attitude drift, which could be mapped in relative detail, became the goal. Momentum control, which was accomplished by pitching the spacecraft in order to balance aerodynamic and gravity gradient torques, was seldom difficult to achieve. Several interesting phenomena observed as part of this activity included occasional momentum wheel instability and a rough correlation between solar flux and the pitch angle required to maintain acceptable momentum. An overview is presented of the attitude behavior of Magsat and some of the control problems encountered. Plausible explanations for some of this behavior are offered. Some of the control philosophy used during the mission is examined and aerodynamic trimming operations are summarized. A.R.H.

N81-11087*# Computer Sciences Corp., Silver Spring, Md.
THE RESPONSE OF THE SEASAT AND MAGSAT INFRARED HORIZON SCANNERS TO COLD CLOUDS
S. Bilanow and M. Phenneger *In* NASA. Goddard Space Flight Center Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 23 p refs (For primary document see N81-11070 02-13)
Avail: NTIS HC A20/MF A01 CSCL 22A

Cold clouds over the Earth are shown to be the principal cause of pitch and roll measurement noise in flight data from the infrared horizon scanners onboard Seasat and Magsat. The observed effects of clouds on the fixed threshold horizon detection logic of the Magsat scanner and on the variable threshold detection logic of the Seasat scanner are discussed. National Oceanic and Atmospheric Administration (NOAA) Earth photographs marked with the scanner ground trace clearly confirm the relationship between measurement errors and Earth clouds. A one to one correspondence can be seen between excursion in the pitch and roll data and cloud crossings. The characteristics of the cloud-induced noise are discussed, and the response of the satellite control systems to the cloud errors is described. Changes to the horizon scanner designs that would reduce the effects of clouds are noted. Author

N81-11088*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACECRAFT MOMENTUM MANAGEMENT PROCEDURES
Lily C. Chen (General Software Corp., Silver Spring, Md.), Paul B. Davenport, and Conrad R. Sturch (Computer Sciences Corp., Silver Spring, Md.) *In its* Fifth Ann. Flight Mech./Estimation Theory Symp. Oct. 1980 19 p refs (For primary document see N81-11070 02-13)
(Contract NAS5-24300)
Avail: NTIS HC A20/MF A01 CSCL 22A

Techniques appropriate for implementation onboard the space telescope and other spacecraft to manage the accumulation of momentum in reaction wheel control systems using magnetic torquing coils are described. Generalized analytical equations are derived for momentum control laws that command the magnetic torquers. These control laws naturally fall into two main categories according to the methods used for updating the magnetic dipole command: closed loop, in which the update is based on current measurements to achieve a desired torque instantaneously, and open-loop, in which the update is based on predicted information to achieve a desired momentum at the end of a period of time. Physical interpretations of control laws in general and of the Space Telescope cross product and minimum energy control laws in particular are presented, and their merits and drawbacks are discussed. A technique for retaining the advantages of both the open-loop and the closed-loop control laws is introduced. Simulation results are presented to compare the performance of these control laws in the Space Telescope environment. A.R.H.

N81-11089# Lincoln Lab., Mass. Inst. of Tech., Lexington. Group 91.
ANODE: AN ANALYTIC ORBIT DETERMINATION SYSTEM, VOLUME 1
Ramaswamy Sridharan and William P. Seniw 24 Jun. 1980 98 p refs
(Contract F19628-80-C-0002; AF Proj. 2129)
(AD-A090118; TN-1980-1-Vol-1; ESD-TR-80-75) Avail: NTIS HC A05/MF A01 CSCL 22/3

The computer system at the Millstone Hill radar was upgraded in August, 1977, with the acquisition of a Harris 7/220 system. The new computer is a virtual memory multitasking system capable of supporting up to 768 K bytes of user program simultaneously. A software system design was made for the radar system with the new computer. One of the components of the system is an on-line real time analytic orbit determination program. The purpose of the program is threefold: (1) it is intended to act as a real-time monitor on the tracking performance of the radar; (2) it is designed

to function as a rapid orbit estimator available interactively to analyst. GRA

N81-11980*# Alabama Univ., Tuscaloosa.
ANALYSIS AND IMPROVEMENT OF CONTACT DYNAMICS SIMULATION USING THE SIX DEGREE OF FREEDOM MOTION SYSTEM
Richard C. Brown *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 50 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 22A

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air)*.

N81-11090# Minnesota Univ., Minneapolis.
STATE OF THE ART AND NEEDS OF THE EARTH PLATFORM
Larry B. Kuechle, Douglas P. DeMaster, and Donald B. Siniff 1979 16 p refs Presented at the 13th Intern. Symp. on Remote Sensing of Environ., Ann Arbor, Mich., 23-27 Apr. 1979
(Contract DE-AS02-76EV-01332)
(CONF-7904140-1) Avail: NTIS HC A02/MF A01

The current state of the art in designing the animal platform segment for use in satellite location systems is outlined. Problems with batteries, antenna design and oscillator stability are discussed. DOE

N81-11984*# Missouri Univ. -Columbia. Dept. of Industrial Engineering.
UPGRADING THE FREE FLYING RENDEZVOUS AND DOCKING SIMULATOR AND THE ORBITAL SERVICER SYSTEM
Robert M. Eastman *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 31 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 14B

N81-11988*# Drake Univ., Des Moines, Iowa. Dept. of Mathematics and Computer Science.
MODELING A MAINTENANCE SIMULATION OF THE GEOSYNCHRONOUS PLATFORM
A. F. Kleiner, Jr. *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 28 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 22B

N81-12004*# Alabama Univ., Tuscaloosa.
ON THE CONTROL AND STABILITY OF THE PINHOLE OCCULTER FLEXIBLE BOOM FACILITY
Michael Greene *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 31 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 14B

N81-12008*# Wisconsin Univ., Platteville.
DEPLOYABLE STRUCTURE DESIGN FOR THE SCIENCE AND APPLICATIONS SPACE PLATFORM
Henry W. Stoll *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 30 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 22B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N81-11091* National Aeronautics and Space Administration, Washington, D. C.
PROJECT INTELSAT 5
1 Dec. 1980 8 p
(NASA-News-Release-80-179; P80-10187) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22B

With 12,000 voice circuits and 2 television channels, intelsat 5, the first of a new generation of international telecommunication satellites, has almost double the communication capability of early satellites in the series. The 1,928 kilogram (at a lunch) satellite will be placed into geosynchronous orbit over the Atlantic Ocean to provide communications between North America and Europe. The characteristics of the Atlas Centaur launch vehicle to be used are described and the flights events of the launch sequence are tabulated. A.R.H.

N81-11092# Committee on Commerce, Science, and Transportation (U. S. Senate).
CIVIL REMOTE SENSING SATELLITE SYSTEM
Washington GPO 1980 241 p refs Hearings before the Subcomm. on Sci., Technol., and Space of the Comm. on Com., Sci., and Transportation, 96th Congr., 2nd Sess., 26 Jun. and 24 Jul. 1980
(GPO-66-554) Avail: Subcommittee on Science, Technology, and Space

Land remote sensing satellite systems are discussed, with emphasis on LANDSAT D and LANDSAT D PRIME. The transitional program to convert the land remote sensing satellite system to civil operation is detailed. Discussions of users requirement and methods of data acquisition are included. S.F.

N81-11093# ARO, Inc., Arnold Air Force Station, Tenn.
MISSILE MOTION SENSITIVITY TO DYNAMIC STABILITY DERIVATIVES Final Report, 1 Oct. 1978 - 30 Sep. 1979
T. F. Langham AEDC Sep. 1980 111 p refs Sponsored by Air Force
(AD-A089750; AEDC-TR-80-11) Avail: NTIS HC A06/MF A01 CSCL 16/2

A dynamic derivative sensitivity study was conducted to demonstrate the importance of dynamic derivatives in missile motion simulation studies. Generalized bank-to-turn and yaw-to-turn missile configurations were used with a six degree of freedom linearized stability program. The effects of various dynamic derivatives on missile stability were investigated in both level and turning flight for several Mach numbers and altitude conditions. GRA

N81-11094# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
DIGITAL SIMULATION FOR DESIGN OF A DISTURBANCE ABSORBING CONTROLLER FOR A FOURTH-ORDER PLANT WITH SECOND-ORDER DISTURBANCE AT INPUT
Wayne L. McCowan and William Hooker 12 May 1980 78 p refs
(AD-A090119; AD-E950029; DRSMI/RG-TR-80-25) Avail: NTIS HC A05/MF A01 CSCL 17/1

A simulation is presented which utilizes user-input plant and state observer pole placement data to generate a disturbance-absorbing control component, uc, which will cancel the effects of a disturbance which is entering the system at the plant input. GRA

N81-11095# Air Force Academy, Colo.
MULTIPLE, INDEPENDENTLY TARGETED REENTRY VEHICLE (MIRV) TARGETING MODELS Final Report, May 1978 - Aug. 1980
R. Warren Langley and Dana Billings Aug. 1980 30 p refs
(AD-A090151; FJSRL-TR-80-0017) Avail: NTIS HC A03/MF A01 CSCL 16/3

A previously reported weapons allocation model was extended

to include multiple independently targeted reentry vehicles (MIRV). Model feasibility is demonstrated through computational testing. Implementation considerations are discussed. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

N81-11096*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PRELIMINARY ARC-JET TESTS OF ABLATOR/RSI JOINTS IN SIMULATED SPACE SHUTTLE ASCENT AND ENTRY HEATING

W. D. Brewer, C. M. Pittman, and S. S. Tompkins Oct. 1980 26 p refs

(NASA-TM-81907) Avail: NTIS HC A03/MF A01 CSCL 22B

Five ablator/RSI panels were tested in simulated Shuttle heating conditions to determine heat pulse effects on the ablator and the ablator/RSI joints. Two of the panels were subjected to both ascent and entry heating. The other three panels were subjected to entry heating only. The double-pulse heating (ascent plus entry) had no significant effect on char-layer integrity. Evaluation of the effects of entry heating on the ablator/RSI joints was difficult because, with the panel configuration used, severe pressure gradients developed within some of the joints during testing causing hot-gas flow through the joints. In joints where pressure leaks apparently did not develop, temperatures within the joints were reasonable compared to ablator and RSI back surface temperatures. Author

N81-11097# Sandia Labs., Albuquerque, N. Mex. Geological Projects Div.

APPLICATION OF ULTRASONICS TO SPACE SHUTTLE TILES

R. M. Zimmerman and P. A. Hogenson 1980 7 p Presented at the ASNT Fall Conf., Houston, Tex., 6 Oct. 1980 Prepared in cooperation with Rockwell International, Downey, Calif.

(Contract DE-AC04-76DP-00789)

(SAND-80-1380C; CONF-801021-1) Avail: NTIS HC A02/MF A01

Two types of discrete sized ceramic tiles bonded to the outer skin of space vehicles are used for the thermal protection of the space shuttle during reentry. Failure of any one of the more than 30,000 tiles on the space shuttle could have significant effects. Ultrasonic testing to establish the soundness of the tiles was evaluated and found to be a viable and valuable method. The method is simple, quick, and has a statistical basis. The testing method involves comparing the measured velocities of finished tiles to velocity-tensile strength relationships obtained for coupons. Acceptance criteria are developed for the computerized data collection and the status of the tile determined automatically. DOE

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

N81-11098# Range Commanders Council, White Sands Missile Range, N. Mex. Telemetry Group.

TELEMETRY STANDARDS: CONTAINING INTERNATIONAL (SI) UNITS AND CONVENTIONAL UNITS Final Report

Sep. 1980 146 p refs Revised

(AD-A089908; IRIG-STANDARD-106-80; IRIG-STANDARD-106-77) Avail: NTIS HC A07/MF A01 CSCL 16/1

The Telemetry Group of the Range Commanders Council (RCC) has prepared this document of standards to foster the compatibility of telemetry transmitting, receiving, and signal processing equipment at all the Test and Evaluation (T E) ranges under the cognizance of the RCC. The Range Commanders highly recommend that telemetry equipment operated at the T E ranges, and telemetry equipment utilized by the range user in programs that require test range support, conform to these standards. These standards do not necessarily define the existing capability of any test range, but constitute a guide for the orderly implementation and application of telemetry systems for both the ranges and range users. The scope of capabilities attainable with the utilization of these standards requires careful consideration of tradeoffs. Guidance concerning these tradeoffs is provided in the text. GRA

N81-11099# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.

STAR PATTERN RECOGNITION AND SPACECRAFT ATTITUDE DETERMINATION, PHASE 2 Interim Report, 1 Oct. 1978 - 30 Sep. 1979

Thomas E. Strikwerda and John L. Junkins Dec. 1979 58 p refs

(Contract DAAK70-78-C-0038)

(AD-A090195; ETL-0211) Avail: NTIS HC A04/MF A01 CSCL 17/7

The purpose of the research activities described in this document is to research and develop a system for on-board attitude determination for satellites, achieving sub-five arc-second accuracy when such a system is interfaced with a general purpose star tracker (typical of several existing configurations). The primary motivation for this research is the exploitation of recently developed light sensitive Charge-Coupled-Devices (CCD) in the focal plane of a tracker lens. The CCD will act as a 'film' for imaging starlight and from which the attitude can be determined. The attitude determination can be performed on-board with a high degree of accuracy and high speed. A typical CCD for this application consists of about 200,000 light-sensitive elements or pixels, accurately imbedded (to 1 part in 10,000) in a microcircuit chip. The CCD can be scanned electronically and the voltage response of illuminated pixels digitized for processing by a microcomputer; corrections can be applied for image distortion based upon a priori calibration. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N81-11100 Columbia Univ., New York.

ASPECTS OF CONTROL OF LARGE FLEXIBLE SPACECRAFT Ph.D. Thesis

Chittur Natarajan Viswanathan 1980 249 p

Avail: Univ. Microfilms Order No. 8023561

A meaningful concept of the degree of controllability of a system is developed which takes into consideration all the pertinent factors such as controllability, total time of control, control effort, stability, and control objective which should have a bearing on the degree of controllability. An algorithm to generate an approximation to this degree of controllability was developed which satisfies the condition that the approximate measure goes to zero if and only if the system becomes uncontrollable. Using this concept it was possible to compare a set of potential control system designs for a given space structure, each using a different distribution of actuator locations, and to decide which design was best. Dissert. Abstr.

N81-11101*# General Dynamics Corp., San Diego, Calif. Advanced Space Programs.

LOW THRUST VEHICLE CONCEPT STUDY Final Report
26 Sep. 1980 291 p refs
(Contract NAS8-33527)
(NASA-CR-161594; GDC-ASP-80-010) Avail: NTIS HC A13/MF A01 CSCL 22B

Low thrust chemical (hydrogen-oxygen) propulsion systems configured specifically for low acceleration orbit transfer of large space systems were defined. Results indicate that it is cost effective and least risk to combine the OTV and stowed spacecraft in a single 65 K Shuttle. The study shows that the engine for an optimized low thrust stage (1) does not require very low thrust; (2) 1-3 K thrust range appears optimum; (3) thrust transient is not a concern; (4) throttling probably not worthwhile; and (5) multiple thrusters complicate OTV/LSS design and aggravate LSS loads. Regarding the optimum vehicle for low acceleration missions, the single shuttle launch (LSS and expendable OTV) is most cost effective and least risky. Multiple shuttles increase diameter 20%. The space based radar structure short OTV (which maximizes space available for packaged LSS) favors use of torus tank. Propellant tank pressures/vapor residuals are little affected by engine thrust level or number of burns. A.R.H.

N81-11102*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
VIKING '75 SPACECRAFT DESIGN AND TEST SUMMARY. VOLUME 3: ENGINEERING TEST SUMMARY
Neil A. Holmberg, Robert P. Faust, and H. Milton Holt Nov. 1980 107 p refs
(NASA-RP-1027-Vol-3; L-12087-Vol-3) Avail: NTIS HC A06/MF A01 CSCL 22B

The engineering test program for the lander and the orbiter are presented. The engineering program was developed to achieve confidence that the design was adequate to survive the expected mission environments and to accomplish the mission objective. T.M.

N81-11103# Toronto Univ., Downsview (Ontario).
ACTIVE CONTROL OF DYNAMICS TRANSFER FUNCTIONS FOR A FLEXIBLE SPACECRAFT
S. C. Garg Oct. 1979 74 p refs
(UTIAS-239; CN-ISSN-0082-5255) Avail: NTIS HC A04/MF A01

Flexible spacecraft consisting of a central rigid body and flexible appendages are examined. The dynamics of each appendage are discussed with emphasis on introducing transfer functions for point excitation in translation and rotation. The transfer matrix for the entire spacecraft is derived and details are given for pitch/twist attitude control of Hermes (CTS). The expressions are found useful in several respects, being devoid of modal truncation. A scheme is examined which modifies the spacecraft transfer function actively using acceleration feedback. Numerical results are obtained for Hermes, and then confirmed from an attitude control simulation incorporating control nonlinearities. Dynamics modification under ground control is also examined, including time delays, and an experiment of this type is proposed for Hermes. R.C.T.

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N81-11104# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
GASEOUS/PARTICULATE ABSORPTION STUDIES AT WSMR USING LASER SOURCED SPECTROPHONES
Young Paul Yee, Charles W. Bruce, and Ralph J. Brewer Aug. 1980 54 p refs
(DA Proj. 1L1-61102-B-53A)
(AD-A089821; ERADCOM/ASL-TR-0065) Avail: NTIS HC A04/MF A01 CSCL 14/2

Field absorption measurements of ambient gases and desert dust were taken using uniquely designed resonant subcavity spectrophones. The gas measuring spectrophone contains an inner acoustical subcavity which essentially eliminates the 'window' noise problem and the dust spectrophone was designed to allow laminar air flow through the microphone so that particle size distributions will be unaltered during measurements. A review of past and present gaseous and particulate absorption measurements in the Atmospheric Sciences Laboratory (ASL) shows frequently good agreement with other independent results such as White cell measurements of methane at deuterium fluoride laser lines (3.5-4.1 micrometer wavelengths), AFGL predictions at CO2 laser lines (9.2-10.8 micrometer wavelengths) for ozone, and Lorenz-Mie calculations for quartz and calcite aerosol particles at the CO2 laser wavelengths. In a number of cases, significant changes to prior published values have also been well substantiated. Using verified absorption coefficients for the atmospheric gases, an on-line/off-line gas analysis at DF laser frequencies was performed for a site at Oscura Peak, White Sands Missile Range (WSMR), NM. Atmospheric gases at the field site were retained in sampling tanks and taken to the laboratory where concentrations of the known gaseous constituents (water vapor, N2O, and CH4) were determined using a self-consistency calculational scheme. Realtime field measurements of atmospheric absorbing gases and dust were then made at a WSMR desert site. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

N81-11105*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE TRANSPORTATION SYSTEM SOLID ROCKET BOOSTER THRUST VECTOR CONTROL SYSTEM
Adas J. Verble, Jr., Alex A. McCool, and Jack H. Potter Oct. 1980 20 p refs
(NASA-TM-78309) Avail: NTIS HC A02/MF A01 CSCL 21H

The Solid Rocket Booster, Thrust Vector Control (TVC) system was designed in accordance with the following requirements: self-contained power supply, failsafe operation, 20 flight uses after exposure to seawater landings, optimized cost, and component interchangeability. Trade studies were performed which led to the selection of a recirculating hydraulic system powered by Auxiliary Power Units (APU) which drive the hydraulic actuators and gimbal the solid rocket motor nozzle. Other approaches for the system design were studied in arriving at the recirculating hydraulic system powered by an APU. These systems must withstand the imposed environment and be usable for a minimum of 20 Space Transportation System flights with a minimum of refurbishment. The TVC system completed the required qualification and verification tests and is certified for the intended application. Substantiation data include analytical and test data. Author

N81-11106# Prototype Development Associates, Inc., Santa Ana, Calif.
DUST EROSION PERFORMANCE OF CANDIDATE MOTOR-CASE THERMAL PROTECTION MATERIALS Final Report, 1 Jan. - 1 Oct. 1979
D. H. Smith 10 Mar. 1980 162 p refs
(Contract DNA001-79-C-0179)
(AD-A090216; PDA-TR-14373-00-05; DNA-5286F) Avail: NTIS HC A09/MF A01 CSCL 21/8

A study was conducted to evaluate the erosion performance of candidate motor-case thermal protection materials for advanced missiles. Available data were compiled and evaluated and empirical expressions were developed to describe the erosion performance of two of the leading candidate materials (VAMAC 15J and Kevlar-epoxy). These expressions then were applied to predict the flight response of these two materials for two design flight trajectories and a simulated freestream dust environment. Finally,

a number of available ground test facilities were evaluated for use in performing erosion tests of materials for ascent flight. Recommendations were made for the optimum facilities to accomplish different types of test objectives. GRA

N81-11107# Johns Hopkins Univ., Laurel, Md. Chemical Propulsion Information Agency.
JANNAF PERFORMANCE STANDARDIZATION SUBCOMMITTEE, 13TH MEETING MINUTES
Henry F. Hege, ed. Jul. 1980 373 p Meeting held in Sacramento, Calif., 14-15 Feb. 1980
(Contract N00024-78-C-5384)
(AD-A089831; CPIA-PUB-321) Avail: NTIS HC A16/MF A01 CSCL 21/8

This publication contains the meeting agenda, minutes, and presentation materials. The main topic includes explanations and status reports on the Interim Solid Performance Program (Interim SPP) and associated program modules. Other topics include: nozzle flow analysis, space motor combustion spin effects, effects of expended inerts/slag, the BARF effect, particle impingement modelling, the Nozzleless Performance Program, thermochemical data, boundary layer analysis, vertical test measurements, and advanced performance methodology. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N81-11108# Battelle Columbus Labs., Ohio.
COMPENDIUM OF INFORMATION ON IDENTIFICATION AND TESTING OF MATERIALS FOR PLASTIC SOLAR THERMAL COLLECTORS
V. D. McGinniss, F. A. Sliemers, D. K. Landstrom, and S. G. Talbert 31 Jul. 1980 389 p refs
(Contract DE-AC84-79CS-30171)
(DOE/CS-30171/1) Avail: NTIS HC A17/MF A01

Topics covered include: (1) rate of aging of polymeric materials; (2) environmental factors affecting performance; (3) evaluation and prediction of service life; (4) measurement of physical and chemical properties; (5) discussion of evaluation techniques and specific instrumentation; (6) degradation reactions and mechanisms; (7) weathering of specific polymeric materials; and (8) exposure testing methodology. Major emphasis was placed on defining the current state of the art in plastics degradation and on identifying information that can be utilized in applying appropriate and effective aging tests for use in projecting service life of plastic solar thermal collectors. DOE

24 COMPOSITE MATERIALS

Includes laminates.

N81-11109*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
CREEP-RUPTURE OF POLYMER-MATRIX COMPOSITES
H. F. Brinson, W. I. Griffith, and D. H. Morris Jul. 1980 35 p refs Presented at Fourth SESA Intern. Congr. on Exptl. Mech., Boston, 26-30 May 1980
(Grant NsG-2038)
(NASA-CR-163706; VPI-E-80-18) Avail: NTIS HC A03/MF A01 CSCL 11D

An accelerated characterization method for resin matrix composites is reviewed. Methods for determining modulus and strength master curves are given. Creep rupture analytical models are discussed as applied to polymers and polymer matrix composites. Comparisons between creep rupture experiments and analytical models are presented. The time dependent creep rupture process in graphite epoxy laminates is examined as a function of temperature and stress level. A.R.H.

N81-11110*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Engineering.
ACCELERATED CHARACTERIZATION OF GRAPHITE/EPOXY COMPOSITES
W. I. Griffith, D. H. Morris, and H. F. Brinson Sep. 1980 28 p refs Presented at the 3d Intern. Conf. on Composite Mater., Paris, 26-29 Aug. 1980
(Grant NsG-2038)
(NASA-CR-163723; VPI-E-80-27) Avail: NTIS HC A03/MF A01 CSCL 11D

A method to predict the long term compliance of unidirectional off-axis laminates from short term laboratory tests is presented. The method uses an orthotropic transformation equation and the time-stress-temperature superposition principle. Short term tests are used to construct master curves for two off-axis unidirectional laminates with fiber angles of 10 and 90 degrees. Analytical predictions of long term compliance for 30 and 60 degrees laminates are made. Comparisons with experimental data are also given. Author

N81-11111*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPLETION OF EVALUATION OF MANUFACTURING PROCESSES FOR B/Al COMPOSITES CONTAINING 0.2mm DIAMETER BORON FIBERS
Thomas J. Moore and Paul E. Moorhead Sep. 1980 39 p refs
(NASA-TM-81573; E-543) Avail: NTIS HC A03/MF A01 CSCL 11D

Four fabricators produced a total of 54 B/1100 Al, B/6061 Al, and B/2024 Al panels for evaluation. The 8 ply unidirectional, 45 to 50 volume percent, panels were made using 0.20 mm diameter boron fibers which were obtained from a single supplier. Hot press consolidation was carried out in vacuum except for one set of dry woven tape panels which were hot pressed in air. A single testing contractor conducted nondestructive inspection, metallography, fractography and mechanical property tests. The mechanical property tests included 21 and 260 C tensile tests and 21 C shear tests. Panel quality, as measured by nondestructive evaluation, was generally good as were the 21 C tensile properties. The panels hot pressed in air delaminated in the shear tests. Shear strength values were lower in these panels. But tensile strengths were not affected by the delaminations because of the relation between the tensile loading direction and the delaminations. Composite tensile strength was found to be proportional to the volume percent boron and the aluminum matrix rather than to the tape used or fabrication technique. Suitability of these composites for 260 C service was confirmed by tensile tests. R.K.G.

N81-11112*# Toronto Univ. (Ontario). Dept. of Electrical Engineering.
ELECTRON BEAM CHARGING AND ARC DISCHARGING OF SPACECRAFT INSULATING MATERIALS Final Report, 1 Oct. 1979 - 30 Sep. 1980
K. G. Balmain Oct. 1980 50 p refs Sponsored in part by AFWL
(Grant NsG-7647)
(NASA-CR-163731) Avail: NTIS HC A03/MF A01 CSCL 11D

The properties of the arc discharges which are caused by the laboratory exposure of dielectric materials to electron beams are examined, the intent being to simulate conditions on synchronous-orbit spacecraft. Extensive experimental studies are reported for planar dielectrics (Teflon, Kapton, Mylar) on the subjects of incident-flux scaling of discharge properties and the effects of high-energy broad-spectrum electron irradiation from a radioisotpe source. In addition a preliminary evaluation is made of the discharge susceptibility of fiber optic waveguides. M.G.

N81-11113*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A PROBABILISTIC ANALYSIS OF ELECTRICAL EQUIPMENT VULNERABILITY TO CARBON FIBERS
Wolf Elber Oct. 1980 31 p refs
(NASA-TM-80217) Avail: NTIS HC A03/MF A01 CSCL 11D

The statistical problems of airborne carbon fibers falling onto electrical circuits were idealized and analyzed. The probability of making contact between randomly oriented finite length fibers

and sets of parallel conductors with various spacings and lengths was developed theoretically. The probability of multiple fibers joining to bridge a single gap between conductors, or forming continuous networks is included. From these theoretical considerations, practical statistical analyses to assess the likelihood of causing electrical malfunctions was produced. The statistics obtained were confirmed by comparison with results of controlled experiments. A.R.H.

N81-11114*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science Mechanics.
THREE DIMENSIONAL INELASTIC FINITE ELEMENT ANALYSIS OF LAMINATED COMPOSITES
Odis H. Griffin, Jr. and Manohar P. Kamat Nov. 1980 175 p refs
(Contract NCCI-15; Grant NGR-47-004-129)
(NASA-CR-163712; VPI-E-80-28) Avail: NTIS HC A08/MF A01 CSCL 11D

Formulations of the inelastic response of laminated composites to thermal and mechanical loading are used as the basis for development of the computer NALCOM (Nonlinear Analysis of Laminated Composites) computer program which uses a fully three dimensional isoparametric finite element with 24 nodes and 72 degrees of freedom. An incremental solution is performed with nonlinearities introduced as pseudoloads computed for initial strains. Equilibrium iteration may be performed at every step. Elastic and elastic-plastic response of boron/epoxy and graphite/epoxy graphite/epoxy and problems of curing [0/90] sub s Gr/Ep laminates with and without circular holes are analyzed. Mechanical loading of [+ or - 45]sub s Gr/Ep laminates is modeled and symmetry conditions which exist in angle-ply laminates are discussed. Results are compared to experiments and other analytical models when possible. All models are seen to agree reasonably well with experimetnal results for off-axis tensile coupons. The laminate analyses show the three dimensional effects which are present near holes and free corners. A.R.H.

N81-11115*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FRACTURE TOUGHNESS OF BORON/ALUMINUM LAMINATES WITH VARIOUS PROPORTIONS OF 0 DEG AND PLUS OR MINUS 45 DEG
C. C. Poe, Jr. and J. A. Sova (Joint Inst. for the Advancement of Flight Sciences, Hampton, Va.) Nov. 1980 39 p refs
(NASA-TP-1707; L-13880) Avail: NTIS HC A03/MF A01 CSCL 11D

The fracture toughness of boron/aluminum laminates was measured on sheet specimens containing central slits of various lengths that represent cracks. The specimens were loaded axially and had various widths. The sheets were made with five laminate orientation. Fracture toughness was calculated for each laminate orientation. Specimens began failing at the ends of the slit with what appeared to be tensile failures of fibers in the primary load carrying laminae. A general fracture toughness parameter independent of laminate orientation was derived on the basis of fiber failure in the principal load carrying laminae. The value of this parameter was proportional to the critical value of the stress intensity factor. The constant of proportionality depended only on the elastic constants of the laminates. Author

N81-11116# General Dynamics/Convair, San Diego, Calif.
DEVELOPMENT OF ADVANCED INTERCEPTOR SUBSTRUCTURAL MATERIAL
Julius Hertz and Norman R. Adsit Aug. 1980 163 p refs
(Contract DAAG46-78-C-0056; DA Proj. 1W1-62113-A-661)
(AD-A090127; AMMRC-TR-80-44) Avail: NTIS HC A08/MF A01 CSCL 11/4

This report is aimed at the development of ultra-high modulus graphite/epoxy structures for use in future advanced terminal interceptors. The work has produced a preliminary full-scale design and demonstrated, experimentally and analytically, that the design will carry the loads. More study needs to be conducted and some further experimental work is recommended before a full-scale article is tested. The present work has concentrated on testing the aft joint and an intermediate ring for holding an equipment package in the frustra. GRA

N81-11117*# Naval Surface Weapons Center, Dahlgren, Va. Environmental Test Chamber.
FIBER RELEASE FROM IMPACTED GRAPHITE REINFORCED EPOXY COMPOSITES Final Report
T. C. Babinsky Jun. 1980 71 p Sponsored by NASA
(NASA-CR-163684; AD-A090112; NSWC/TR-80-216) Avail: NTIS HC A04/MF A01 CSCL 11D

Carbon fibers released from composites by aircraft fires and crashes can cause electrical shorts and consequent equipment damage. This report investigates less vigorous release mechanisms than that previously simulated by explosive burn/blast tests. When AS/3501-6 composites are impacted by various head and weight configurations of a pendulum impactor, less than 0.2 percent by weight of the original sample is released as single fibers. Other fiber release mechanisms studied were air blasts, constant airflow, torsion, flexural, and vibration of composite samples. The full significance of the low single fiber release rates found here is to be evaluated by NASA in their aircraft vulnerability studies. GRA

N81-11118# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
MICROCRACKING IN GRAPHITE-EPOXY COMPOSITES Interim Report
Ernest G. Wolff 1 Sep. 1980 34 p refs
(Contract F04701-79-C-0080)
(AD-A089894; TR-0080-5950-01-1; SD-TR-80-65) Avail: NTIS HC A03/MF A01 CSCL 11/4

Microcracking in composite materials is commonly caused by ply stiffness variations in crossply layup during application of applied stress, and by differential thermal expansion coefficients of the fiber and the matrix during thermal excursions. It is responsible for changes in macro- and micromechanical properties, permeability to gases, and dimensional instability. Theories, experimental techniques, and effects of microcracking are reviewed. The coefficient of cracking expansion is defined, and procedures for reducing deleterious effects of microcracking on composite structures are presented. GRA

N81-11119# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
WAVE PROPAGATION IN ANISOTROPIC LAYERED MEDIA Phase Report
William R. Scott 17 Jun. 1980 25 p refs
(AD-A090014; NADC-80099-60) Avail: NTIS HC A02/MF A01 CSCL 11/2

A mathematical treatment is presented for the problem of a plane wave obliquely incident upon an attenuating layered anisotropic medium. Detailed treatment is given for cases of interest for laminated composite materials. GRA

N81-11120# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
COMPATIBILITY OF AIRCRAFT OPERATIONAL FLUIDS WITH A GRAPHITE/EPOXY COMPOSITE: DEVELOPMENT OF AN EXTERIOR COATING SYSTEM AND REMOVER Final Report
K. G. Clark 26 Jun. 1980 43 p refs
(ZF54502001)
(AD-A090049; NADC-80046-60) Avail: NTIS HC A03/MF A01 CSCL 11/4

The objective of this investigation is the identification of aircraft operational and specialty chemical which are potentially detrimental to the integrity of organic matrix composites. In this report, results of several studies made with the graphite/epoxy Hercules AS/3501-6 are disclosed. Several alternatives to the problem of paint removal are discussed. It is concluded that water and maintenance fluids containing water produce significant plasticization of graphite/epoxy, while most solvents, oils, hydraulic fluids, and fuel cause no significant mechanical losses. Paint removal was found to be a significant problem due to the activity of chemical removers. Removal is complicated by the fact that stripping thermoset coatings from graphite/epoxy is more difficult than stripping from aluminum. A 'weak link' coating system using a nitrocellulose primer is, thus far, the best strippable composite coating if used with the simple methylene chloride remover designated 4-70-1. It is recommended that confirmational testing with tensile, flexure, compression, fatigue and dynamic

mechanical specimens of graphite/epoxy and possibly some adhesive, be made. Following these tests, the nitrocellulose/polyurethane coating system should be field tested on graphite/epoxy aircraft substrates. GRA

N81-11121# Celanese Research Co., Summit, N.J.
DESIGN AND WEAVING OF EXPERIMENTAL CARBON FABRICS Technical Report, Jul. 1978 - Jan. 1980
R. A. Bonsall Wright-Patterson AFB, Ohio AFWAL Apr. 1980 43 p refs
(Contract F33615-78-C-5043; AF Proj. 2417)
(AD-A089775; AFWAL-TR-80-4054) Avail: NTIS HC A03/MF A01 CSCL 11/5

Polyacrylonitrile (PAN preoxidized fibers were processed and subsequently woven into various carbon fabrics of low thermal conductivity. The axial thermal conductivity of the yarn variants was determined using a Colora thermoconductometer. The values ranged from 0.0072 cal/cm-sec-deg C to 0.0128 cal/cm-sec-deg. C and three of the variants met the thermal conductivity target of 0.010 cal/cm-sec-deg C or less. Fiber densities and carbon contents exceeded the targets because of the pyrolysis temperature used. At the specified pyrolysis temperature, 1075 C, the more critical thermal conductivity requirement was met, but at the expense of density and carbon content. The density of the fibers examined ranged from 1.742 g/cc to 1.789 g/cc. The carbon composition of the fabrics ranged from 79.86% to 86.17%. Cost estimates for reproducing each of the fabrics studied on a commercial scale were prepared. The estimates ranged from $35.54/yd. to $85.74/yd. The effects of increasing the yarn size and also fabric weaving prior to carbonization were examined from both a cost and physical properties standpoint. GRA

N81-11122# AiResearch Mfg. Co., Torrance, Calif.
EVALUATION OF FILAMENT-WOUND KEVLAR-49/EPOXY FATIGUE PROPERTIES Final Report
3 Jun. 1980 32 p refs Prepared for California Univ., Lawrence Livermore Lab.
(Contract W-7405-eng-48)
(UCRL-15264) Avail: NTIS HC A03/MF A01

The long term properties of Kevlar-49/epoxy composite was investigated in a fatigue and elevated temperature environment to provide additional information on the material properties of Kevlar-49/epoxy for use in the design of composite flywheel energy storage units. Results indicate that Kevlar-49 has the unusual property of increasing tensile modulus of elasticity under fatigue loading conditions. The change in modulus was shown to be a function of temperature, induced stress level, and number of fatigue cycles. The average modulus before cycling was 13.28 x 10 to the 6th power psi at ambient temperature versus 11.96 x 10 to the 6th power psi at 150 F. Creep or residual strain after 100,000 cycles was 4.1 x 10 the minus 4th power in/in (ambient) and 11.7 x 10 to the minus 4th power in/in (150 F) at 140 ksi maximum stress level. At 190 ksi temperature did not show any effects on creep, which was measured to be approximately 28 x 10 to the minus 4th power in/in. The ultimate strength of 150 F rings was 249,000 psi compared to 262,000 psi for ambient temperature. DOE

N81-11123# California Univ., Berkeley. Lawrence Berkeley Lab.
INFLUENCE OF SURFACE SILICA IMPURITIES ON THE SINTERING BEHAVIOR OF ALUMINA POWDERS
Jose S. Moya and Joseph A. Pask Feb. 1980 25 p refs Presented at the 9th Intern. Symp. on the Reactivity of Solids, Krakow, Poland, 1-6 Sep. 1980
(LBL-10392; CONF-800902-1) Avail: NTIS HC A02/MF A01

The filtering, pressing and sintering behavior of an alumina powder with and without silica impurity on surface is discussed. When silica is removed from surface by HF-treatment and compactibility is considerably enhanced due to the different acidity/basicity nature of the OH of the hydroxyl layers. The silica impurity decreases the activation energy of the initial stage of sintering and grain boundary energy, improves the densification process and exerts a moderate inhibitor effect on the grain growth. DOE

N81-11124# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
Al2O3 ADHERENCE ON CoCrAl ALLOYS M.S. Thesis
Lori McConnell Kingsley 1980 111 p refs
(Contract W-7405-eng-48)
(LBL-10952) Avail: NTIS HC A06/MF A01

Adherence of protective oxides on NiCrAl and CoCrAl superalloys was promoted by a dispersion of a highly oxygen reactive element or its oxide being produced within the protection system. Two aspects of this subject are investigated here: the use of Al2O3 as both the dispersion and protective oxide; and the production of an HfO2 dispersion while simultaneously aluminizing the alloy. It was found that an Al2O3 dispersion will act to promote the adherence of an external scale of Al2O3 to a degree comparable to previously tested dispersion and an HfO2 dispersion comparable to that produced by a Rhines pack treatment is produced during aluminization. DOE

N81-11125# California Univ., Livermore. Materials Test and Evaluation Section.
ACOUSTIC EMISSION FOR QUALITY CONTROL OF KEVLAR 40 FILAMENT-WOUND COMPOSITES
Marvin A. Hamstad Jan. 1980 15 p refs Presented at the 12th Natl. Soc. for the Advan. of Mater. and Process Eng. Tech. Conf., Seattle, 7-9 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-83783; CONF-801010-1) Avail: NTIS HC A02/MF A01

The relationship of production variables to changes in proof-test-generated acoustic emission (AE) from NASA type filament wound pressure vessels was studied. Some of the deliberate manufacturing errors were matrix content, cure cycle, matrix component ratios, degraded fiber, moisture content, and winding tension. The 11 cm diameter spherical pressure vessels were made by filament winding Kevlar 49/epoxy on aluminum mandrels. After proof testing, the vessels were burst tested. Certain production variables resulted in significant changes in AE amplitude and associated stress level. DOE

N81-11126# California Univ., Livermore. Lawrence Livermore Lab. Chemistry and Materials Science Dept.
FAILURE MODES AND DURABILITY OF KEVLAR/EPOXY COMPOSITES
Rogers J. Morgan, Eleno Mones, Wayne J. Steele, and Suzanne B. Deutscher Jun. 1980 13 p refs Presented at the 12th Natl. SAMPE Tech. Conf., Seattle, 7-9 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-83875; CONF-801010-2) Avail: NTIS HC A02/MF A01

The fracture topographies of Kevlar 49/epoxy composite strands and multilayer composites in the form of pressure vessels are discussed in terms of the microscopic deformation and failure processes of the composites. The effect of resin ductility and fiber-matrix interfacial bond strength on mechanisms of fiber damage are considered. The failure of the Kevlar 49 fibers by a splitting process and the parameters, such as fiber fibrillation and macromolecular chain scission, that control such a process, are discussed in relation to fiber and composite performance. DOE

N81-11127# Ad-Ex International, Portola Valley, Calif.
BORON CARBIDE: HIGH-PERFORMANCE INDUSTRIAL MATERIAL. PART 2: INDUSTRIAL APPLICATIONS OF BORON CARBIDE
M. Beauvy (Saclay Nuclear Research Center, France) and F. Thevenot (Ecole Nationale Superieure des Mines de St.-Etienne, France) Dec. 1979 22 p refs Transl. into ENGLISH from Ind. Ceram. (France), no. 734, Dec. 1979 Sponsored by DOE Prepared for Battelle Pacific Northwest Labs., Richland, Washington
(PNL-TR-405-Pt-2) Avail: NTIS HC A02/MF A01

As boron carbide is considered a strategic material in the nuclear and military fields, applied research work on this material was principally oriented toward applications in these two sectors. Hence, today the greatest tonnage of industrially produced boron carbide is used for the manufacture of absorbers for nuclear power plants and for the manufacture of light armors. It is probable that the orientation of these studies and the nondisclosure of

the results of research in these two high technology areas have done little to favor the development of the numerous other industrial applications one might expect in view of the properties of boron carbide. Better knowledge of the mechanisms controlling the mechanical and physical properties of the carbide is needed before one can conceive new openings for this promising product, particularly in technology for new energy sources. It is also possible to find the means to increase the oxidation resistance of boron carbide without altering its properties. This will make it possible to extend further the area of its industrial applications. DOE

N81-11128# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

EFFECT OF SERVICE ENVIRONMENT ON COMPOSITE MATERIALS

Aug. 1980 326 p refs In ENGLISH; partly in FRENCH Presented at the 50th Meeting of the AGARD Struct. and Mater. Panel, Athens, 14-17 April 1980

(AGARD-CP-288; ISBN-92-835-0273-6) Avail: NTIS HC A15/MF A01

The effects of environmental and mechanical stress on the composite materials of aircraft structures are described. Graphite-epoxy and carbon fiber reinforced plastics are tested for fatigue and tensile creep. Effects of environmental temperature and moisture (humidity) are emphasized. Applications for aerodynamic and aerospace engineering are included. For individual titles, see N81-11129 through N81-11149.

N81-11129# British Aerospace Aircraft Group, Preston (England). Advanced Structural Applications Dept.

THE IMPLICATIONS OF LABORATORY ACCELERATED CONDITIONING OF CARBON FIBRE COMPOSITES

E. C. Edge *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 17 p refs (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

The evidence on the effects of long term natural weathering of carbon fiber composites is examined and its implications with regard to the conditioning of test specimens discussed. The effects of laboratory accelerated tests on the properties of some composite materials are considered in conjunction with the relevance of data thus acquired to real life situations and the need to generate the data with reasonable speed for design considerations. The changes in conditioning procedure which have taken place are outlined along with the factors which have influenced these changes. Author

N81-11130# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.

EFFECT OF VARIOUS ENVIRONMENTAL CONDITIONS ON POLYMER MATRIX COMPOSITES

R. C. Tennyson *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 21 p refs (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

Experimental results obtained on the short and long term behavior of polymer matrix composites subjected to various environmental conditions are given. Changes in mechanical stiffness, strength and coefficient of thermal expansion were measured under ambient pressure and thermal vacuum conditions. In all tests involving the vacuum environment, measurements were made in-situ, necessitating the use of mechanical loading fixtures acting through flexible bellows to provide stiffness and strength data. Results are given on the effects of varying some fabrication parameters (length of post-cure time and rate of cool-down in autoclave) on the changes observed in strength and stiffness. The materials investigated include: graphite/epoxy, boron/epoxy, PRD-49/epoxy and E glass/epoxy. S.F.

N81-11131# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. for Structural Mechanics.

PREDICTABILITY OF MOISTURE ABSORPTION IN GRAPHITE/EPOXY SANDWICH PANELS

H. W. Bergmann and P. Nitsch *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 11 p refs (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

Graphite/epoxy materials tend to degrade in hot and moist environments. The high dependence of the strength loss on the moisture content demands an assessment of the amount and distribution of absorbed moisture, particularly in the case of lightweight sandwich panels. The reliability of such predictions hinges on the formulation of theoretical considerations, the accuracy of numerical processes, the definition of material constants and a proper interpretation of the environmental conditions. The impact of errors in these parameters on predicted moisture contents, and comparisons of analytical forecasts with experimentally determined values, are the topics of this paper. S.F.

N81-11132# Istituto di Tecnologia Aerospaziale, Rome (Italy).

EFFECTS CONNECTED WITH THE SPACE ENVIRONMENT ON COMPOSITE MATERIALS

Renato Barboni, Mario Marchetti, and Isidoro Peroni *In* AGARD Effects of Serv. Environ. on Composite Mater. Aug. 1980 20 p refs (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

Experimental and analytical results for the mechanical and thermal behavior of carbon fiber pultrusion and laminate. Particular attention is paid to the temperature effects on the static mechanical characteristics and their nonhookean behavior for the range 300 to 450 K. Dynamic tests in order to find the internal damping are described. The linear coefficients of thermal expansion, are reported for the temperature range 150 to 400 K. Calculated values of thermal expansion are in close agreement with those measured. S.F.

N81-11133# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

CONSTANT-AMPLITUDE AND FLIGHT-BY-FLIGHT TESTS ON CFRP SPECIMENS

F. J. Arendts, K. O. Sippel, and D. Weisgerber *In* AGARD Effects of Serv. Environ. on Composite Mater. Aug. 1980 12 p refs Sponsored in part by Ministry of Defense (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

Constant amplitude and flight by flight tests with five different load spectra were done with unnotched carbon fiber reinforced plastic specimens. The influence of overloads was investigated. The test results were compared with fatigue life predictions based on 'miner's rule' applied for different conditions. Overloads in all cases cause a significant reduction of the fatigue life. Fatigue life estimations based on 'miner's rule' are on the unsafe side in some cases by more than a factor 10, getting a big scatter among the cases investigated. S.F.

N81-11134# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).

FATIGUE STRENGTH OF CFRP UNDER COMBINED FLIGHT-BY-FLIGHT LOADING AND FLIGHT-BY-FLIGHT TEMPERATURE CHANGES

J. J. Gerharz and D. Schuetz *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 24 p refs (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

Influence of environment on the fatigue of carbon fiber reinforced plastics unnotched, notched and bolted specimens is studied. The specimens are simultaneously subjected to load and environmental histories. A flight by flight load and environment sequence typical for the wing root of a fighter airplane is applied. Tests with simplified simulation of environment, allowing high loading frequencies, are run. The admissibility of the simplifications is evaluated by comparing the results of each simplified test with the results from long time quasi real time test with temperatures accompanying the loads in each flight. The 'quasi real time' flight by flight program includes temperature cycles and a humidity cycle. The specimens are heated and cooled by preconditioned air forced through the test chamber. The results of room temperature fatigue tests and of static tests at various environmental conditions are available. For a constant fatigue stress level residual strength and stiffness data demonstrate the damage growth made apparent by ultrasonic scan records. S.F.

N81-11135# Royal Netherlands Aircraft Factories Fokker, Rijswijk.

FATIGUE TEST RESULTS OF CARBON FIBER REINFORCED PLASTIC F28 AIRCRAFT COMPONENT AND ITS STRUCTURAL DETAILS

J. A. A. M. Dijns *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 5 p (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

As a part of the development program on the structural application of carbon fiber reinforced plastic composites in aircraft structures, a speedbrake was designed and built in carbon fiber reinforced plastics and aramide fiber composites. Different configurations were studied and one was selected for a detailed design in the form of a schematic model. Test were carried out on structural details and two schematic speedbrake models were fabricated for full scale static and dynamic load tests. One speedbrake was produced for flight testing on an operational aircraft. The tests resulted in a design of the speedbrake in which no metal parts were used and in which all joints were bonded with 120 C and room temperature curing adhesives, without the use of additional fasteners. The first model speedbrake was successfully tested to ultimate load without failure or any plastic deformation. The second model speedbrake was tested at a maximum fatigue load equal to 65 percent of the ultimate load. The full size CFRP speedbrake showed a weight saving of 25 percent when compared with the Al alloy design. S.F.

N81-11136# General Dynamics Corp., Fort Worth, Tex. Materials Research Lab.

EFFECTS OF TEMPERATURE AND MOISTURE ON THE CREEP COMPLIANCE OF GRAPHITE-EPOXY COMPOSITES

K. G. Kibler *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 8 p refs (For primary document see N81-11128 02-24)

(Contract F33615-77-C-5109)

Avail: NTIS HC A15/MF A01

Time-dependent environmental behavior of graphite-epoxy composites used in aerospace structural applications is described. Experimental and analytical results are presented for the individual and coupled effects of temperature and absorbed moisture on the creep compliance of unidirectional and cross-plied composites. Measurement of tensile creep response at room temperature and four elevated temperatures (up to the glass transition region of the materials) for dry specimens and for specimens moisture-saturated at 75 percent and 95 percent relative humidity is presented. The stress levels used are demonstrated to be within the range of linearly viscoelastic response. Superposition techniques are used to determine compliance master curves from the results for individual temperature and moisture conditions. S.F.

N81-11137# Royal Aircraft Establishment, Farnborough (England). Materials Dept.

RELATIONSHIPS BETWEEN IMPACT RESISTANCE AND FRACTURE TOUGHNESS IN ADVANCED COMPOSITE MATERIALS

G. Dorey *In* AGARD Effects of Serv. Environ. on Composite Mater. Aug. 1980 11 p refs (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

A variety of CFRP laminates and one GRP laminate were subjected to impact by steel balls, over a range of incident energies, and residual strengths were measured. Superimposed static load during impact substantially altered the residual strength curves. The laminates were also tested with machined notches and analyzed in terms of fracture toughness. Results of impact performance both during impact and in subsequent residual strength tests were compared, with the aim of correlating service performance with laboratory toughness tests. Effects of materials and geometric variables are discussed together with possibilities for improvements. R.K.G.

N81-11138# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Div. Helicopteres.

EROSION AND IMPACTS ON COMPOSITE HELICOPTER BLADES [EROSION ET IMPACTS SUR LES PALES D'HELICOPTERES EN COMPOSITES]

M. Torres *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 10 p In FRENCH (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

Helicopter rotors are subjected to a certain number of aggressions associated with the environment in which they rotate. The use of new materials such as carbon and glass epoxy composites requires the manufacturer to conduct specific qualification research programs for each of these aggressions. The modes of degradation from rain and sand erosion and from civil and military impacts on blades made of composite materials are presented. Research on erosion enabled selection of the most effective protective materials. Experience in the use of blades as well as results from firing and impact tests show an excellent fatigue behavior after shocks and impact, due in a large measure to the fail-safe character of composite materials. This good behavior, associated with the possibility of very extensive repairs, is an important factor to the superiority of composite blades over metal blades. Transl. by A.R.H.

N81-11139*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

GRAPHITE-EPOXY PANEL COMPRESSION STRENGTH REDUCTION DUE TO LOCAL IMPACT

Michael F. Card and Marvin D. Rhodes *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 13 p refs (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01 CSCL 11D

The effects of low velocity impact on the compressive strength of graphite/epoxy structures are reviewed. Extensive tests were conducted on sandwich beams, laminated plates and stiffened panels. Conditions for failures were investigated by impact tests on statically loaded test specimens. Lightly loaded graphite structures (such as aircraft secondary structure) were insensitive to impact damage. In more heavily loaded structures, (such as wing panels), appreciable reductions in compressive strength occurred. The implications of the tests for structural design are discussed by comparing panel masses for designs where ultimate strains were reduced due to impact considerations with the masses of designs with higher ultimate strains. Preliminary test data are presented to show the possibility of improvements in damage to tolerance achievable by using an alternate matrix material. R.K.G.

N81-11140# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Bauweissen-und Konstruktionsforschung.

THE INFLUENCE OF DEFECTS ON THE BEHAVIOUR OF COMPOSITES

R. Aoki and K. Stellbrink *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 25 p refs (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

The load carrying capacity of composite structures in aircrafts, spacecrafts etc., is greatly influenced by inherent defects or damages induced during utilization. The effect of simulated defects on the fatigue behaviour and residual strength of GFRP and CFRP laminates is reported. Two kinds of mechanically produced damages in thin laminates caused by dropped tools: a three square identation generated by a tapered triangular tip and a delamination zone produced by a ball shaped tip are discussed. The investigated materials are epoxy resins reinforced with E-glass fabric as well as T300 carbon fiber fabric and unidirectional layup with various orientation sequences. R.K.G.

N81-11141# Centre d'Essai Aeronautique, Toulouse (France).

ASSESSING THE BEHAVIOR OF HIGH MODULUS COMPOSITE MATERIALS IN LIGHTNING [EVALUATION DU COMPORTEMENT A LA FOUDRE DE STRUCTURES EN MATERIAUX COMPOSITES HAUT MODULE]

J. Rouchon and D. Gall *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 14 p In FRENCH (For primary document see N81-11128 02-24)

Avail: NTIS HC A15/MF A01

Lightning strikes of aircraft in flight are relatively frequent and result in damage and even destruction to both equipment and structures, particularly those made of composite materials.

Generalities about lightning are reviewed and methods for measuring it during flight and simulating it on the ground are described. Results are presented for laboratory tests on carbon-epoxy monolithic and boron-epoxy coated sandwich specimens, and on the elements of real structures. Associated control processes are also considered. Transl. by A.R.H.

N81-11142# Boeing Co., Seattle, Wash.
LIGHTNING PROTECTION CONSIDERATIONS FOR GRAPHITE/EPOXY AIRCRAFT STRUCTURE
S. D. Schneider *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 6 p refs (For primary document see N81-11128 02-24)
Avail: NTIS HC A15/MF A01

When advanced composites such as graphite/epoxy were first being considered for aircraft structure, a common belief was that lightning would heavily damage the structure. This belief has since proven to be false. Advanced composites react to lightning strikes in a manner different from aluminum, but the resultant damage is by no means alarming. Two basic types of lightning damage to which aircraft structures are subjected, are discussed. Known, documented techniques and design philosophies for protection against lightning caused structural damage are reviewed for classical aluminum aircraft structure fabricated with metal fasteners, and the impact of graphite/epoxy on these classical approaches is addressed. Detailed lightning test criteria, test techniques, and criteria are also given and related to graphite structures. R.K.G.

N81-11143*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE POTENTIAL FOR DAMAGE FROM THE ACCIDENTAL RELEASE OF CONDUCTIVE CARBON FIBERS FROM AIRCRAFT COMPOSITES
Vernon L. Bell *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 21 p refs (For primary document see N81-11128 02-24)
Avail: NTIS HC A15/MF A01 CSCL 11D

Carbon and graphite fibers are known to be electrically conductive. The rapidly accelerating use of carbon fibers as the reinforcement in filamentary composite materials brought up the possibility of accidental release of carbon fibers from the burning of crashed commercial airliners with carbon composite parts. Such release could conceivably cause widespread damage to electrical and electronic equipment. The experimental and analytical results of a comprehensive investigation of the various elements necessary to assess the extent of such potential damage in terms of annual expected costs and maximum losses at low probabilities of occurrence are presented. A review of NASA materials research program to provide alternate or modified composite materials to overcome any electrical hazards from the use of carbon composites in aircraft structures is described. R.K.G.

N81-11144*# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering.
EROSION OF COMPOSITE MATERIALS
George S. Springer *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 9 p refs (For primary document see N81-11128 02-24)
Avail: NTIS HC A15/MF A01 CSCL 11D

A model for describing the response of uncoated and coated fiber reinforced composites subjected to repeated impingements of liquid (rain) droplets is presented. The model is based on the concept that fatigue is the dominant factor in the erosion process. Algebraic expressions are provided which give the incubation period, the rate of mass loss past the incubation period, and the total mass loss of the material during rain impact. The influence of material properties on erosion damage and the protection offered by different coatings are discussed and the use of the model in the design in the design of structures and components is illustrated. R.K.G.

N81-11145# Westland Helicopters Ltd., Yeovil (England).
FATIGUE AND DAMAGE PROPAGATION IN COMPOSITE ROTOR BLADES
A. J. Barnard *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 17 p Sponsored by Ministry of Defense, England (For primary document see N81-11128 02-24)
Avail: NTIS HC A15/MF A01

The development and flight evaluation of carbon/glass fiber reinforced plastic rotor blades is considered. Results are presented from tests undertaken on tail and main blades. The excellent fatigue and damage propagation characteristics of the composite blades are emphasized. The rig and flight tests demonstrated unlimited fatigue lives for the composite blades and the structural element tests indicated low material scatter factors in both static and fatigue cases. Test results also indicate improved safety through the use of composite blades. J.M.S.

N81-11146# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
SERVICE EXPERIENCE WITH GRC HELICOPTER BLADES (BO-105)
K. Brunsch *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 17 p refs (For primary document see N81-11128 02-24)
Avail: NTIS HC A15/MF A01

The service experience of light helicopters (BO-105) both for civil and military operations is discussed with emphasis on data accumulated on composite (GRC) rotor blades. Full scale fatigue test results with new blades and blades after 4000 hours of flight are compared as are coupons cut out of blades before and after thousands of service hours. Impact strength and erosion-corrosion problems are among the factors considered. J.M.S.

N81-11147*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPOSITE COMPONENTS ON COMMERCIAL AIRCRAFT
H. Benson Dexter *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 22 p refs (For primary document see N81-11128 02-24)
Avail: NTIS HC A15/MF A01 CSCL 11D

Flight experience gained with numerous composite aircraft structures is discussed. Both commercial transports and helicopters are included. Design concepts with significant mass savings and appropriate inspection and maintenance procedures are among the factors considered. Also, a major NASA/U.S. industry technology program to reduce fuel consumption of commercial transport aircraft through the use of advanced composites is described, including preliminary results. Ground and flight environmental effects on the composite materials used in the flight service programs are also discussed. J.M.S.

N81-11148# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Systems Support Div.
AIR FORCE APPLICATIONS AND IN-SERVICE EXPERIENCE WITH COMPOSITE STRUCTURES
Frank J. Fechek *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 10 p (For primary document see N81-11128 02-24)
Avail: NTIS HC A15/MF A01

Advanced composite development programs which contribute to the capability to use these materials in primary and secondary structures on high performance military aircraft are described. Emphasis is placed on a systematic, periodic nondestructive evaluation of selected composite structures in operational service. Visual and X-radiographic inspection techniques are shown to be quite usable on composite strucutres in the field. However, inefficiencies using available, portable ultrasonic inspection equipment in the field environment accentuate the need for the development of a semi-automated, ultrasonic inspection system specifically designed to be compatible with current, production composite aircraft structures. A system satisfying these needs is shown to be feasible. J.M.S.

N81-11149# Naval Air Systems Command, Washington, D. C.
US NAVY SERVICE EXPERIENCE WITH ADVANCED COMPOSITES
A. Somoroff, M. Dubberly, J. M. McGinn, M. Tarricone, and A. Manno (Naval Air Development Center, Warminster, Pa.) *In* AGARD Effect of Serv. Environ. on Composite Mater. Aug. 1980 16 p refs (For primary document see N81-11128 02-24)
Avail: NTIS HC A15/MF A01

Lifetime durability information encompassing laboratory programs, exposure of ground specimens and observation of flight structures is presented. The specific structures discussed include the F-14 horizontal stabilizer and the H-46 rotor blade which are in production, and the YAV-8B wing developed for production of the AV-8B. Also discussed are S-3 spoilers and F-4 access doors which were developed exclusively to acquire service data. It is noted that the F-18 aircraft makes extensive use of graphite-epoxy composites in primary wing, horizontal stabilizer, and vertical stabilizer skin structure. As of the end of February 1980, eleven F-18 development aircraft are engaged in flight test evaluation. A cumulative total of more than 900 flight hours have been accumulated with the highest number of flight hours for an individual aircraft being 214 and the longest calendar service time for an individual aircraft being 18 months. During this period the graphite-epoxy structure has performed well and without incident. J.M.S.

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also 77 *Thermodynamics and Statistical Physics*.

N81-11150 Stanford Univ., Calif.
MODIFICATION OF SURFACE REACTIONS ON Ni(100) BY ABSORBED SULFUR Ph.D. Thesis
Steven Willard Johnson 1980 543 p
Avail: Univ. Microfilms Order No. 8024680

The effects of sulfur on the absorption and desorption behavior of hydrogen and carbon monoxide and on surface reactions of alcohols and aldehydes on Ni(100) were investigated under ultra high vacuum (UHV) conditions by temperature programmed reaction spectroscopy (TPRS). The formation and stability of sulfurized surfaces, prepared by the thermal decomposition of hydrogen sulfide adsorbed at 300K, were monitored by Auger electron spectroscopy, low energy electron diffraction, and TPRS. The well defined surfaces with one-quarter and one-half monolayers of adsorbed sulfur were found to be thermally stable to 900K, chemically stable under UHV conditions with respect to the adsorbates used here, and to inhibit the formation of surface carbon by promoting diffusion of carbon into the bulk. The effects of sulfur on the surface reactions of alcohols and aldehydes resulted in the stabilization of larger, adsorbed molecules, molecular fragments, or intermediates and may be seen as a combination of ligand and ensemble effects. The results of this study also provided insight into methanation on nickel and its poisoning by sulfur. Dissert. Abstr.

N81-11151 Missouri Univ. -Columbia.
A PROGRAMMABLE CHROMATOGRAPHIC SEPARATION SYSTEM: SPECIFICATIONS AND DESIGN Ph.D. Thesis
Jesse Wilson Hartley 1979 208 p
Avail: Univ. Microfilms Order No. 8024357

The design and operation of a user programmable chromatographic separation system is discussed. The instrument allows the user to perform several types of chromatography. These include gel permeation, adsorption, and gel permeation followed by absorption, all with associated sample storage, fractionation, and solvent gradient elution. Adsorption chromatography may be done by two columns in series with reverse flow elution of the adsorbed compounds. The user is allowed to control the elution manually or by storing a sequence of commands for later execution. The chromatograph includes two gel columns, forty-eight adsorption columns, twenty-three sample storage loops, up to eight solvent reservoirs, and constant displacement pump. The microprocessor-based controller is programmed by the user in a specially designed high level language. Current system function is shown through a back lit display. Communication with the operator is through a function oriented display. The processor directly controls the solvent pump, the valves in the chromatograph, and the front panel display. Dissert. Abstr.

N81-11152 Missouri Univ. -Columbia.
THERMAL PROPERTIES OF A LOW MELTING TEMPERATURE EUTECTIC SALT STORED IN PARALLEL PANS Ph.D. Thesis
Sang Ha No 1979 162 p
Avail: Univ. Microfilms Order No. 8024384

A study of a salt hydrate eutectic as a heat storage medium was conducted. An eutectic melting at approximately 55 F was used. The eutectic sale was sealed in pan-shaped containers and these containers were placed in parallel in an insulated chamber. With the parallel pan heat storage unit, the local air temperature distributions in the X and Y direction between parallel pans, the eutectic salt temperature distribution in the container and the actual heat storage capacity of the eutectic were examined. Also, equations to predict local Nusselt numbers and the local mean air temperature were developed. The hydrodynamic Reynolds number ranged from 3322 to 9967. Two levels of entering air temperature, 40 F and 45 F, were used to cool the eutectic. Also, two entering air temperatures, 65 F and 75 F, were used to heat the eutectic. The percent relative humidity of the air entering the heat storage was held constant at 67 plus or minus 2%. Dissert. Abstr.

N81-11153 Maryland Univ., College Park.
HETEROGENEOUS GAS-SOLID REACTION STUDIES IN A HIGH TEMPERATURE DIFFUSION CELL: THE EFFECT OF SODIUM-CHLORIDE ON SULFUR CAPTURE IN FLUIDIZED BED COMBUSTION Ph.D. Thesis
Tevfik Bardakci 1980 342 p
Avail: Univ. Microfilms Order No. 8025236

A single pellet high temperature diffusion cell reactor was developed to study heterogeneous gas solid reactions where the structure of the solid changes with time. The effect of sodium chloride on the reaction of SO2/O2 mixtures with Greer limestone is used as an example system. The system has useful applications in characterizing sulfur capture in fluidized bed combustors. The single pellet high temperature diffusion cell reactor was designed and constructed to measure the effective diffusivity of argon and nitrogen through the porous limestone matrix during calcination, sintering and sulfation reactions. The results reveal that the following equation can be used to estimate the effective diffusivity of argon through calcined Greer limestone as a function of temperature (775 to 1000 C) and calcination time. D sub Ar = 62.3 (-14600/RT) + 113.6 theta e (-29400/RT) where D sub Ar is the effective diffusivity of argon in sq cm/sec. T is the absolute temperature in K, and theta is the calcination time in hours. The diffusivity of argon and nitrogen through the internal structure increased when the calcined Greer limestone pellet was exposed to NaCl vapor. The average pore radius increased and the surface area decreased as the exposure to NaCl in Greer limestone was increased. Dissert. Abstr.

N81-11154*# Lunar and Planetary Inst., Houston, Tex.
MELTING RELATIONS AND ELEMENTAL DISTRIBUTION OF PORTION OF THE SYSTEM Fe-S-Si-O TO 32 KB WITH PLANETARY APPLICATION
Wuu-Liang Huang Oct. 1980 23 p refs
(NASA-CR-163713) Avail: NTIS HC A02/MF A01 CSCL 07D

The melting relations and distribution of K and Cs in portions of the system was determined at high pressures. Ferrosilite is stable as a primary phase at high pressures because of the incongruent melting of ferrosilite to quartz plus liquid and the boundary between the one and two liquid fields on the joint Fe(1-x) O-FeS-SiO2 shifts away from silica with increasing pressures. Potassium K was found to have limited solubility in metal sulfide liquids at pressures up to 45 kb. The speculation that K may dissolve significantly in metal-metal sulfide liquids after undergoing first order isomorphic transition was tested by determining the distribution of Cs between sulfide and silicate liquids as an analogy to K. At 45 kb, 1400 C and 27 kb, 1300 C only limited amounts of Cs were detected in quench sulfide liquids even at pressures beyond the isomorphic transition of Cs. R.K.G.

N81-11155# Aerodyne Research, Inc., Bedford, Mass. Center for Chemical and Environmental Physics.
QUANTITATIVE INFRARED SPECTROSCOPIC MEASURE-

MENTS OF BORON FLUORIDES Final Report, 1 Apr. 1977 - 30 Mar. 1980
Michael E. Gersh, Charles E. Kolb, Mark S. Zahniser, Lawrence S. Bernstein, Joel A. Silver, Robert G. Brown, Conrad M. Gozewski, Spiros Kallelis, Joda C. Wormhoudt, and Lauren M. Peterson (Environmental Research Inst. of Michigan, Ann Arbor) Aug. 1980 146 p refs
(Contract F49620-77-C-0075)
(AD-A089743; ARI-RR-225; AFOSR-80-0942TR) Avail: NTIS HC A07/MF A01 CSCL 07/4

The objective of this research is the performance of quantitative infrared spectroscopic measurements of boron fluorides and oxides in the gas phase. The measurement program is designed to determine infrared absorption coefficients and absorption line spacings in order to facilitate the construction of infrared radiation band models. In order to carry out these measurements an apparatus which permits the performance of quantitative spectroscopic measurements of transient species over the temperature range of 300 to 1500 K was constructed. The capability of this apparatus to perform these measurements over its designed range of operating parameters was demonstrated. The infrared absorption coefficients of the nu-3 band of BF3 were measured over the range of 300 to 1500 K. These measurements were combined with flame measurements at 2400 K to develop and verify a radiation band model for BF3. The formalism developed for this band model is more comprehensive than previous treatments and is generally applicable to perpendicular bands of symmetric top molecules. The infrared band strength of BF was measured. The band strength was determined by measuring the absorption cross section of a single vibration-rotation line using a tunable diode laser as the light source. The BF number density was measured in-situ using ultraviolet absorption spectroscopy. GRA

N81-11156# Kentucky Univ., Lexington.
GAS ADSORPTION BY ACTIVATED AND IMPREGNATED CARBONS Final Quarterly Progress Report, 9 May 1974 - 31 Dec. 1979
P. J. Reucroft, C. T. Chiou, C. P. Madhusudhan, P. B. Rao, and G. B. Freeman Sep. 1980 44 p refs
(Contract DAAA15-74-C-0163; DA Proj. 1W7-62710-A-095) (AD-A089984; AD-E410313; ARCSL-CR-80014; QPR-19) Avail: NTIS HC A03/MF A01 CSCL 07/4

Adsorption data have been obtained for hydrogen cyanide, cyanogen chloride, phosgene, water vapor and binary vapors on BPL activated carbon, ASC whetlerite carbon and several related carbons. The data have been interpreted in terms of the Dubinin-Polanyi isotherm equation and heats of adsorption have been determined in selected systems. GRA

N81-11157# American Univ., Washington, D. C.
DEFINITION OF CHEMICAL AND ELECTROCHEMICAL PROPERTIES OF A FUEL CELL ELECTROLYTE Final Technical Report, 25 Mar. 1977 - 24 Jun. 1980
R. T. Foley Jun. 1980 71 p refs
(Contract DAAK70-77-C-0080; DA Proj. 1K1-61102-AH-51) (AD-A089776) Avail: NTIS HC A04/MF A01 CSCL 07/4

The research was oriented toward the task of developing an improved electrolyte for the hydrocarbon-air fuel cell. A literature study of the properties of organic acids indicated that the following types of compounds warranted investigation: aromatic polycarboxylic acids, perfluoroaliphatic carboxylic acids, mono, di and poly sulfonic acids, and substituted sulfonic acids. This was followed by an experimental program wherein the vapor pressure, wetting characteristics, electrical conductivity, chemical stability, and electrochemical stability of specific compounds were measured. The following compounds (acids) were among those evaluated: dichloroacetic, d1-10-camphor sulfonic, heptafluorobutyric, ethanedisulfonic, sulfosalicyclic, benzenesulfonic, 1,3,6 - napthalene trisulfonic, sulfosuccinic, sulfopropionic, methanedisulfonic, propanesulfonic, methanesulfonic, ethanesulfonic, and sulfoacetic. Most attention was given to the last three acids. The electrochemical behavior of methanesulfonic acid, ethanesulfonic acid, and sulfoacetic acid as fuel cell electrolytes was studied in half cells at various temperatures. The rate of the electro-oxidation of hydrogen at 115 C was very high in methanesulfonic acid and sulfoacetic acids. The rate of the electro-oxidation of propane in methanesulfonic acid and ethanesulfonic acid at 80 C and 115 C was low. GRA

N81-11158# Pittsburgh Univ., Pa. Dept. of Chemistry.
A STUDY OF OXIDE-SUPPORTED HOMOGENEOUS CATALYSTS Final Report, 1 Jul. 1977 - 30 Jun. 1980
David M. Hercules 19 Sep. 1980 28 p refs
(Contract DAAG29-79-C-0113; Grant DAAG29-77-G-0165) (AD-A089956; ARO-14839.3-C) Avail: NTIS HC A03/MF A01 CSCL 07/4

The analog of RhCl(CO)(PPh3)2 was supported on both silica and alumina. Infrared and ESCA were used to study changes which occur when the complex reacts with CO. On silica, initially a square planar dicarbonyl complex is formed and at higher CO pressures a dimeric species. On alumina both the square planar and penta-coordinated dicarbonyls are formed. Dimeric species are formed from each kind of dicarbonyl and can be distinguished by their infrared spectra. The supported complex listed above was used to study the liquid phase hydroformylation of 1-hexene. The observed activity and selectivity correlate with the nature of the Rh species on both silica and aluminum supports, as characterized by ESCA and IR. Under mild hydroformylation conditions the concurrent isomerization of olefin is catalyzed by the Rh complex and not by the support. Free phosphene in solution completely eliminates isomerization. The support influences the species that initiates the hydroformylation reaction and consequently influences the products of the reaction. GRA

N81-11159# North Carolina Univ. at Chapel Hill. Dept. of Chemistry.
SYNTHESIS AND CHARACTERIZATION OF METALLO-ORGANIC CONDUCTING MATERIALS WITH TETRAAZAANNULENES
William E. Hatfield 5 Sep. 1980 19 p refs Submitted for publication
(Contract N00014-76-C-0816)
(AD-A089940; TR-12) Avail: NTIS HC A02/MF A01 CSCL 07/3

A brief survey is given of research on mixed valence tetraazaannulene complexes. A series of macrocyclic tetraazaannulene complexes are included with emphasis on Cu(2+), Ni(2+), CO(2+), Pd(2+), and Pt(2+) and their partially oxidized reaction products. It is shown that the electrical conductivities and activation energies of some of these compounds approach those of the partially oxidized metallophthalocyanines which ehibits metal-like temperature dependencies of sigma, and of the partially oxidized metalloporphyrins. R.C.T.

N81-11160# Pennsylvania State Univ., University Park. Dept. of Chemistry.
SYNTHESIS OF ALKYLPHOSPHAZENES VIA COPPER-PHOSPHAZENE INTERMEDIATES Interim Report
Harry R. Allcock, Paul J. Harris, and Mark S. Connolly 22 Sep. 1980 54 p refs Submitted for publication
(Contract N00014-75-C-0685; NR Proj. 356-577)
(AD-A089838; TR-17) Avail: NTIS HC A04/MF A01 CSCL 07/3

A new reaction route has been developed for the synthesis of a hitherto inaccessible series of 1,1-dialkyltetrachlorocyclotriphosphazenes. The high yield route involves the interaction of hexachlorocyclotriphosphazene, (NPCl2)3, with alkyl Grignard reagents in the presence of n-Bu3PCuI4, followed by treatment with alkyl halides. The structural characterization of these compounds by NMR and mass spectrometric techniques is discussed, together with the reaction mechanisms. GRA

N81-11161# Oklahoma Univ., Norman. Dept. of Chemistry.
SYNTHESIS OF TETRAPHENYLSTRANNACYCLOPENTADIENES (STANNOLES). 3. ATTEMPTED ROUTE TO THE PARENT STANNOLES THROUGH CLOSURE OF 1,4-DICHLOROBUTA-1,3-DIENE
W.-Z. Min Rhee and J. J. Zuckerman 10 Jan. 1980 13 p refs Submitted for publication
(Contract N00014-77-C-0432; Grant NSF CHE-78-26548; NR Proj. 053-639)
(AD-A090013; TR-22) Avail: NTIS HC A02/MF A01 CSCL 07/3

1,4-Dichlorobuta-1,3-diene has been lithiated and reacted

with organosilyl and tin chlorides. Only polymerized starting material, rather than the hoped for parent sila- and stannacyclopentadienyl (silole and stannole) ring systems result from the action of the lithiated material on diorganodichlorosilanes and diorganotin dichlorides. Addition of the lithiated butadiene to trimethylchlorosilane and trimethyltin chloride yields products resulting from dehydrochlorination and multiple bond migration in the starting dichlorobutadiene. GRA

N81-11162# California Univ., Berkeley. Lawrence Berkeley Lab.

CONDENSATION FILM COEFFICIENTS FOR MIXTURES OF ISOBUTANE AND ISOPENTANE

B. W. Tleimat, H. Rie (Envirotech-Sephton Development Center, Emeryville, Calif.), A. D. K. Laird, and S. Zhao May 1980 6 p refs Presented at the 15th IECEC, Seattle, 18-22 Aug. 1980 Prepared in cooperation with California Univ., Richmond and the Sea Water Conversion Lab

(Contract W-7405-eng-48)

(LBL-11025; CONF-800806-34) Avail: NTIS HC A02/MF A01

Research designed to obtain baseline data on heat transfer for working fluids in geothermal binary cycle systems is described. The working fluid loop in the experimental apparatus simulates the binary cycle with steam as the heating fluid and a throttling valve instead of the turbine. Data on film coefficient for the condensation of 90/10 and 80/20 mixtures of isobutane-isopentane on a horizontal tube at various temperatures and condensation rates are presented. Data indicate that mixtures of isobutane-isopentane have lower condensation film coefficients than that of the pure isobutane under equivalent conditions of temperatures and condensation rates. Depending on the mass condensation rate, the film coefficient for the 80/20 mixture can be as low as 30 percent of the film coefficient for pure isobutane at the same mass condensation rate. DOE

N81-11163# California Univ., Berkeley. Lawrence Berkeley Lab. Dept. of Mechanical Engineering.

STRUCTURE OF A POLYETHYLENE OPPOSED FLOW DIFFUSION FLAME

W. J. Pitz, N. J. Brown, and R. F. Sawyer Aug. 1980 28 p refs Presented at the 18th Combust. Symp., Waterloo, Canada, 18-22 Aug. 1980

(Contracts W-7405-eng-48; NBS-8-05180; NBS-G-7-9006)

(LBL-10784; CONF-800809-5) Avail: NTIS HC A03/MF A01

Structural measurements were obtained and compared with other investigations of diffusion flames. Departures from the commonly assumed collapsed flame model of laminar diffusion flames were observed in terms of excessive CO concentrations and oxygen penetration into the fuel side of the flame. An upper bound on the importance of oxygen diffusion to the fuel surface and subsequent surface oxidation was placed at 20% of the energy required for fuel pyrolysis, with the remainder of the energy being delivered to the surface from the flame through heat transfer processes. As the oxygen concentration in the oxidizer flow was decreased and extinction conditions approached, the CO/CO2 ratio at the flame increased slightly, the oxygen concentration at the luminous flame zone decreased, the flame standoff distance decreased, and the flame temperature decreased. DOE

N81-11164# California Inst. of Tech., Pasadena. Materials and Molecular Research Div.

REACTIVITY PATTERNS OF TRANSITION METAL HYDRIDES AND ALKYLS Ph.D. Thesis

William Davidson Jones, II May 1979 178 p refs

(Contract W-7405-eng-48)

(LBL-10214) Avail: NTIS HC A09/MF A01

The complex PPN(+)CpV(CO)3H(-)(Cp = eta5-C5H5 and PPN = (PhsP)2 was prepared in 70% yield and its physical properties and chemical reactions investigated. PPN(+)CpV(CO)3H(-) reacts with a wide range of organic halides. The organometallic products of these reactions are the vanadium halides PPN(+)(CpV(C)3X)(-) and in some cases the binuclear bridging hydride PPN(+)(CpV(CO)3]2H(-). The reaction between CpV(CO)3H(-) and organic halides was investigated and compared with halide reductions carried out using tri-n-butyltin hydride. In general, CpV(CO)3H(-) appears to transfer a hydrogen atom to the metal radical anion formed in an electron transfer process, whereas CpMo(CO)3H transfers hydride in a 2 electron process to a vacant coordination site. The chemical consequences are that CpV(CO)3H(-) generally reacts with metal alkyls to give alkanes via intermediate alkyl hydride species whereas CpMo(CO)3H reacts with metal alkyls to produce aldehyde, via an intermediate acyl hydride species. DOE

N81-11165# Los Angeles-Orange County Metropolitan Area Project, Whittier, Calif.

SOME LASER TECHNIQUES FOR CHEMICAL DETECTION

Robert K. Sander and Melvin I. Buckwald 1980 10 p refs Presented at the Symp. on Toxic Substance Control Decontamination, Columbus, Ohio, 22-24 Apr. 1980

(Contract W-7405-eng-36)

(LA-UR-80-2076; CONF-8004104-1) Avail: NTIS HC A02/MF A01

Spectroscopy provides a fast sensitive method for chemical analysis. Wavelength tunable lasers can be used for spectroscopic chemical identification by means of techniques such as optoacoustic spectroscopy, thermal lensing, and fluorescence excitation. These methods all share the useful characteristic that their detection sensitivity to small quantities of chemical improves with higher laser intensity. Apparatuses to use these techniques for trace chemical identification and detection were developed. A useful improvement to thermal lensing was developed. DOE

N81-11166# Ames Lab., Iowa. Dept. of Chemistry.

INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROSCOPY: A COMPUTER CONTROLLED, SCANNING MONOCHROMATOR SYSTEM FOR THE RAPID DETERMINATION OF THE ELEMENTS M.S. Thesis

March Alan Floyd Mar. 1980 156 p refs

(Contract W-7405-eng-82)

(IS-T-891) Avail: NTIS HC A08/MF A01

A computer controlled, scanning monochromator system specifically designed for the rapid, sequential determination of the elements is described. The monochromator is combined with an inductively coupled plasma excitation source so that elements at major, minor, trace, and ultratrace levels may be determined, in sequence, without changing experiment parameters other than the spectral line observed. A number of distinctive features not found in previously described versions are incorporated into the system here described. Performance characteristics of the entire system and several analytical applications are discussed. DOE

N81-11167# Mound Lab., Miamisburg, Ohio.

CONSISTENT SPHERICAL POTENTIAL FUNCTION FOR PARA HYDROGEN

G. T. McConville 1980 17 p refs Presented at the 14th Intern. Conf. on Thermodyn. and Statist. Mech., Edmondton, Alberta, Canada, 17 Aug. 1980

(Contract DE-AC04-76DP-00053)

(MLM-2740(OP); CONF-800830-1) Avail: NTIS HC A02/MF A01

Five recently proposed potential functions were compared to data for the second viral coefficient, the bound state energy difference, the differential and total scattering cross sections. None of the potentials can describe the data in a consistent way. Using the Hartree-Fock Dispersion form of Ahlrich, et al, and allowing the dispersion damping parameter to be varied, it is found that D = 1.31 produces a consistent description of all the properties except the differential cross section data. DOE

N81-11168# Oak Ridge National Lab., Tenn. Chemical Technology Div.

CHEMICAL CLASS FRACTIONATION AND THERMOPHYSICAL PROPERTY MEASUREMENTS OF SOLVENT REFINED COAL LIQUIDS

J. D. Hewitt and B. R. Rodgers 1980 22 p refs Presented at the 25th Natl. Technicians Symp., 180th Natl. Meeting of the ACS, Las Vegas, Nev., 24-29 Aug. 1980

(Contract W-7405-eng-26)

(CONF-800814-9) Avail: NTIS HC A02/MF A01

A method of solubility class fractionation originally developed for petroleum asphalts was adapted to coal liquids. The component classes - asphaltols, asphaltenes, resins, and oils - were separated

according to their solubilities in benzene, pentane, and propane. Important physical and thermodynamic properties (viscosity, density, dielectric constant, and conductivity) of these fractions were determined as a function of temperature. Density was most affected by the solids, as expected; however, the dielectric constant was most affected by the asphaltols, the viscosity by the resins (closely followed by the asphaltenes), and the conductivity by the resins. The asphaltols contain the most polarizable material and the resins the most ionizable material. DOE

N81-11169# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
FORMATION AND DESTRUCTION OF POLLUTANTS IN COMBUSTION PROCESSES: CLEARING THE AIR ON THE ROLE OF COMBUSTION RESEARCH
Robert F. Sawyer Aug. 1980 40 p refs Presented at the 18th Combust. Symp., Waterloo, Canada, 18-22 Aug. 1980
(Contract W-7405-eng-48)
(LBL-11237; CONF-800809-6) Avail: NTIS HC A03/MF A01

The rapid increase in the combustion of fossil fuels of the past thirty years has resulted in well identified air pollution problems on both local and global scales. Five pollutant categories are discussed the direct pollutants (COm SO2, particulates, and nitrogenous compounds); acid rain; photochemical smog; carbon dioxide; and carcinogens. Emission standards for cars and light duty trucks are tabulated. The application of combustion research and technology has provided an efficient means, often the most cost effective, of reducing pollutant emissions. The fundamental understanding of the chemical and physical processes leading to the formation of pollutants was critical to the modification of combustion processes for the minimization of pollutants. Both the prevention of formation and the promotion of destruction of pollutants have proven effective. Chemical kinetics can produce time scales for pollutant formation and destruction which are difficult to manipulate in practical combustors in a manner compatible with efficient combustion. DOE

N81-11170# New York Univ., N. Y. Courant Mathematics and Computing Lab.
APPLICATION OF AN EXPLICIT NUMERICAL METHOD TO A REACTION DIFFUSION SYSTEM IN COMBUSTION
R. D. Reitz Nov. 1979 54 p refs
(Contract DE-AC02-76ER-03077)
(COO-3077-162) Avail: NTIS HC A04/MF A01

Numerical methods were applied to one dimensional unsteady reaction diffusion equations to seek propagating wave solutions. These equations describe flame propagation in certain combustion systems. The steady flame speed is invariant under this coordinate transformation. Model reaction diffusion equations which admit traveling waves as exact solution were formulated and one of these was solved. The diffusion terms was differenced using the explicit methods introduced by Saul'yev. Both implicit and explicit techniques for the reaction rate terms were tested. Results indicate that numerical diffusion can reduce accuracy significantly, that numerical dispersion truncation errors can reduce accuracy if they are sufficiently large, and that an accurate representation of the reaction rate in the difference equations is important to retain overall accuracy. One of the explicit methods was also applied to an ozone decomposition flame computation. DOE

N81-11171# EIC, Inc., Newton, Mass.
LOW TEMPERATURE THERMOCONVERSION OF BIOMASS TO USEFUL CHEMICALS BY LEWIS ACID CATALYSTS, PHASE 1 Final Report, 1 Oct. 1979 - 31 Mar. 1980
V. R. Koch and G. H. Schnaper Mar. 1980 28 p refs
(Grant NSF PFR-79-17513)
(PB80-200462; NSF/RA-800067) Avail: NTIS HC A03/MF A01 CSCL 07D

Lewis acids such as aluminum chloride (AlCl3) were used for thermoconversion of lignocellulosic materials (biomass) into useful organic materials. Temperatures used in the process were lower than those heretofore reported. A renewable domestic resource such as biomass provides an alternative source of industrially important organic materials. Use of a temperature range between those of liquefaction and biological fermentation insures product selectivity at reasonable reaction rates. Rice hulls and AlCl3 were heated in an argon filled reactor from ambient to 175 C. Reaction products collected from 120 C to 175 C consisted of CO, CO2, acetone, methyllsobutyl ketone, and three unidentified carbohydrates. GRA

N81-11172# Ionics, Inc., Watertown, Mass.
SOLAR POWERED ELECTRODIALYSIS. PART 1: DESIGN OF A SOLAR POWERED ELECTRODIALYSIS SYSTEM FOR DESALTING REMOTE, BRACKISH WATER SOURCES Final Report
Dec. 1979 172 p
(Contract DI-14-34-0001-8576)
(PB80-203805; W80-06001) Avail: NTIS HC A08/MF A01 CSCL 07D

Alternative design of a solar powered electrodialysis system were evaluated for a desalting application that is typical of the brackish water sources in the southwestern United States. The designs were evaluated relative to total water costs for an average water production of 4,000 gallons per day where the solar isolation averages 24 million joules per square meter per day (10 hours of collection) and the feed water contains 2,200 parts per million of dissolved solids. GRA

N81-11987*# Athens Coll., Ala. Dept. of Biology.
CONTINUOUS FLOW ELECTROPHORESIS: THE EFFECT OF SAMPLE CONCENTRATION ON THROUGHPUT AND RESOLUTION IN AN UPWARD FLOWING SYSTEM
Thomas S. Jandebeur *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 27 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 07D

N81-11992*# Colgate Univ., Hamilton, N.Y. Dept. of Chemistry.
PHOTOCHEMISTRY OF MONODENTATE AND BIDENTATE CARBONATO COMPLEXES OF RHODIUM (3)
Peter S. Sheridan *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 22 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N81-11173 Florida Univ., Gainesville.
A STUDY OF THE EFFECTS OF STRESS ON STRAIN AGING IN VANADIUM AND TANTALUM Ph.D. Thesis
Linda Priscilla Beckerman 1980 214 p
Avail: Univ. Microfilms Order No. 8025362

Strain aging under constant stress was investigated in the Snoek ordering region by means of yield point return tests. The kinetics of Snoek strain aging were found to be independent of aging stress at 353 and 363 K and occurred at a rate 10 times faster than predicted by theory at 338 K. It is postulated that the interstitial atoms which are primarily responsible for the yield point return reorder at a more rapid rate when they are in the high intensity strain fields close to a dislocation. The maximum yield point return due to Snoek ordering was found to be independent of temperature between 353 and 373 K, and decreased when the temperature was increased to 393 and 403 K. While aging at a stress level corresponding to the maximum yield return, the specimens deformed at a rate only 2.5 orders of magnitude slower than the prestrain strain rate. Strain aging under constant stress was investigated in the Cottrell strain aging region by means of yield point return tests. The activation energy of Cottrell strain aging was found to be independent of stress. Dissert. Abstr.

N81-11174 Stanford Univ., Calif.
CHEMICAL DIFFUSION IN LITHIUM ALLOYS Ph.D. Thesis
Chung John Wen 1980 266 p
Avail: Univ. Microfilms Order No. 8024754

Several electrochemical transient methods were employed in combination with the coulometric titration curve, to evaluate

the chemical diffusion coefficient and its compositional dependence. The thermodynamic information obtained as well as the results of the diffusion measurements were used to calculate the lithium self diffusion coefficient as a function of composition in various single phase alloys with the assumption that the lithium atoms dominate the mass transport process. Diffusion measurements were made on two solid phases within the Li-Al system at various temperatures. The chemical diffusion coefficient across the vario-stoichiometric intermediate phase LiAl was shown to be several orders of magnitude higher than that in the terminal solid solution of lithium in aluminum. The intermediate phase LiAl has appreciable values of the thermodynamic enhancement factor, reaching 70 near the Li deficient phase boundary. This leads to very high values of the chemical diffusion coefficient, becoming 10 to the minus 4th power cu cm/sec at those compositions. Dissert. Abstr.

N81-11175 Stanford Univ., Calif.
ELECTROCHEMICAL AND THERMODYNAMIC INVESTIGATION OF TERNARY LITHIUM-TRANSITION METAL-OXYGEN CATHODE MATERIALS Ph.D. Thesis
Ned Allen Godshall 1980 257 p
Avail: Univ. Microfilms Order No. 8024663

Ternary lithium transition metal oxygen systems were investigated for use as reversible cathode materials in high temperature lithium batteries. Possible applications of these types of electrochemical cells included electric vehicle propulsion and electric utility load leveling. These transition metal oxide systems were studied because of the reduced corrosive nature of oxides compared with the sulfides used currently in other programs. Significant results are reported. Dissert. Abstr.

N81-11176 Stanford Univ., Calif.
MECHANICAL AND SURFACE ELECTROSTATIC BEHAVIOR OF COPPER SINGLE CRYSTALS IN ULTRA-HIGH VACUUM Ph.D. Thesis
Robert Chow 1980 234 p
Avail: Univ. Microfilms Order No. 8024634

Experiments on deformation-induced work function changes were performed on copper single crystals of various orientations. The measurements were carried out in an ultra-high vacuum environment after in vacuo cleaning of the surfaces. The cleaning treatment consisted of cycles of ion sputtering and annealing. Simultaneous load, displacement and contact potential difference measurements were made. A displacement transducer, based on the capacitive method, was designed and fabricated in-house. This capacitive strain gauge had a maximum sensitivity of 0.001% strain at a gap spacing of 2 mils. The contact potential difference measurements were made by the modified Kelvin Probe method and to a resolution of 0.1 mV. The vibrator and pre-amp circuit were designed and fabricated in-house for ultra-high vacuum operation. The load was varied incrementally through a stainless steel bellows on a linear feedthrough arrangement.
Dissert. Abstr.

N81-11177 Florida Univ., Gainesville.
OPTICAL STUDIES OF DEZINCIFICATION IN ALPHA-BRASS Ph.D. Thesis
John Edmund Finnegan 1980 123 p
Avail: Univ. Microfilms Order No. 8025372

Experimental studies were undertaken to investigate the dezincification behavior of various copper-zinc alloys. This investigation was conducted in order to confirm or refute reports in the literature, that red brasses (copper alloys having a zinc concentration of less than 15%) are 'immune' to dezincification. Differential reflectometry was applied in conjunction with electrochemical methods as a means of identifying and characterizing possible dealloying of alpha-brasses. It was established that both red and yellow brasses undergo dezincification. Additionally, the dealloying behavior of red and yellow brasses exhibited several strong similarities; the intensity of the dezincification spectrum increased with increasing time, the average alloy composition was not significantly altered with increasing potentiostating times, and the calculated surface loss of zinc, as a result of selective leaching, was approximately 4 at. % for each. The apparent solid state transport mechanism of zinc atoms to the solid/solution interface is enhanced volume diffusion.
Dissert. Abstr.

N81-11178*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF MECHANICAL SURFACE AND HEAT TREATMENTS ON EROSION RESISTANCE
Joshua Salik and Donald H. Buckley 1980 10 p refs Proposed for presentation at the Intern. Conf. on Wear of Materials, San Francisco, 30 Mar. - 1 Apr. 1980
(NASA-TM-81540; E-326) Avail: NTIS HC A02/MF A01 CSCL 11F

The effects of mechanical surface treatments as well as heat treatments on the erosion resistance of 6061 aluminum alloy and 1045 steel were studied. Mechanical surface treatments were found to have little or no effect on the erosion resistance. This is due to the formation by particle impact of a work hardened surface layer regardless of the initial surface condition. The erosion resistance of Al single crystals is found to be independent of orientation. This is due to destruction of the surface microstructure and formation of a polycrystalline surface layer by the impact of erodant particles as observed by X-ray diffraction. While upon solution treatment of annealed 6061 aluminum the increase in hardness is accompanied by an increase in erosion resistance, precipitation treatment which causes a further increase in hardness results in slightly lower erosion resistance. Using two types of erodant particles, glass beads and crushed glass, the erosion rate is found to be strongly dependent on erodant particle shape, being an order of magnitude higher for erosion with crushed glass as compared to glass beads. While for erosion with glass beads heat treatment of 1045 steel had a profound effect on its erosion resistance, little or no such effect was observed for erosion with crushed glass. R.K.G.

N81-11179# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Materials Engineering.
THE ROLE OF HYDROGEN ON ENVIRONMENTAL FATIGUE OF HIGH STRENGTH ALUMINUM ALLOYS
R. J. Jacko and D. J. Duquette 24 Sep. 1980 11 p refs
(Contract N00014-75-C-0466; NR Proj. 036-093)
(AD-A090184) Avail: NTIS HC A02/MF A01 CSCL 11/6

An extensive series of experiments have been performed on a 7075 aluminum alloy and its high purity analogue, Al5Zn2.5Mg, in aqueous environments, to determine the role of cathodically evolved hydrogen on fatigue crack initiation and early propagation. Variables in the program include the effects of applied potential, hydrogen damage reversibility, solution pH and mechanical loading modes. Results obtained in the program refute the concept that anionic species need be specific to cause enhanced susceptibility to fatigue cracking, but that hydrogen, both in the presence or absence of significant corrosion, is indeed a potent species for the degradation of fatigue properties. Evidence is presented that hydrogen, presumed to be associated with the plastic zone at crack tips, causes increased crack propagation rates and also results in significant changes in fracture surface morphologies. Evidence is described which strongly suggests that the ingress of hydrogen may be related to the structure and properties of the oxide film(s) which are formed under given environmental circumstances. GRA

N81-11180# Reynolds Metals Co., Richmond, Va. Metallurgical Research Div.
THE DEVELOPMENT OF ALUMINUM-LITHIUM ALLOYS Final Report
Frank W. Gayle 31 Jul. 1980 178 p refs
(Contract N00019-78-C-0485)
(AD-A090138) Avail: NTIS HC A09/MF A01 CSCL 11/6

Aluminum-lithium based alloys have shown promise as high strength, high modulus, low density alloys, but suffer from low toughness levels currently unacceptable in aerospace design. The present study was directed toward increasing the fracture toughness of such alloys in sheet form, primarily through alloying. Attempts to increase fracture toughness were made through modification of the fracture-controlling Al3Li precipitate, addition of dispersoid-forming elements, and the use of coprecipitation of other phases. GRA

N81-11181# RCA Labs., Princeton, N. J.
CORROSION OF METAL FILMS WITH DEFECTIVE SURFACE PROTECTION LAYERS
R. B. Comizzoli, L. K. White, W. Kern, and G. L. Schnable Griffiss

AFB, N.Y. RADC Jul. 1980 137 p refs
(Contract F30602-78-C-0276; AF Proj. 2306)
(AD-A090028; PRRL-79-CR-42; RADC-TR-80-236) Avail: NTIS HC A07/MF A01 CSCL 11/6

Corrosion of thin-film aluminum and gold under defect-containing passivation layers of phosphorus-doped SiO2 and plasma-deposited silicon nitride was investigated. Metal test patterns with corresponding passivation patterns, including deliberate passivation defects, made it possible to measure both corrosion current and corrosion rate. Measurements were done as a function of relative humidity and temperature. Electrochemical bias techniques were used to determine the relative corrosion stabilities of various metallized substrates. Fluoride and chloride contaminants produced greatly accelerated corrosion reactions for aluminized films. Alloying aluminum films improved their corrosion stability. The H2 in the forming gas ambient during alloying further improved the corrosion stability. Measurements of film stress versus corrosion stability did not correlate well. However, films under compressive stress may exhibit an improved corrosion stability. Fluorescent pH indicators were tested as a method of decorating IC devices. On aluminized IC devices in the presence of bias, some indicators exhibited fluorescence at localized sites. The effect on corrosion current of various surface treatments such as heating, etching, storage, and surface chemical modification were examined. Application of hexamethyldisilazane reduced surface currents by a factor varying from 100X to 1000X. GRA

N81-11182# Harvard Univ., Cambridge, Mass. Div. of Applied Science.
DIFFUSION AND STRUCTURAL RELAXATION IN COMPOSITIONALLY MODULATED AMORPHOUS METAL FILMS
M. P. Rosenblum, F. Spaeden, and D. Turnbull 19 Feb. 1980 7 p refs
(Contract N00014-77-C-0002; Grant NSF DMR-77-24295)
(AD-A090148; TR-8) Avail: NTIS HC A02/MF A01 CSCL 11/6

The interdiffusivity in compositionally modulated amorphous films was measured by monitoring the satellite of the X-ray scattering peak during isothermal anneals in the range 210-250 C. The diffusivity decreased continuously during the annealing as a result of structural relaxation and settled down to a constant value only after many hours of annealing. T.M.

N81-11183# Florida Univ., Gainesville.
AN INVESTIGATION INTO THE SUSCEPTIBILITY OF TANTALUM AND VANADIUM TO SLOW STRAIN-RATE EMBRITTLEMENT DUE TO OXYGEN, NITROGEN AND CARBON Final Report, 1 Apr. 1979 - 30 Jun. 1980
R. E. Reed-Hill and A. E. Diaz 31 Aug. 1980 35 p refs
(Grants DAAG29-79-G-0050; DAAG29-77-G-0080)
(AD-A090199; ARO-14096.2-MS) Avail: NTIS HC A03/MF A01 CSCL 11/9

The phenomena of slow strain-rate embrittlement was studied in three metal-interstitial systems, tantalum-oxygen, vanadium-oxygen and tantalum-nitrogen. The embrittlement of tantalum by oxygen was investigated on specimens containing four levels of oxygen -- 0.33, 0.50, 0.85 and1.30 atomic percent. All of the compositions showed embrittlement between 500-1000 K in specimens deformed at epsilon = 8.8 x 10 to the 4th power sec to the minus one power. Associated with the embrittling phenomenon, and occurring in the same temperature range where the ductility is dropping, and three dynamic strain-aging effects: (a) a yield stress plateau from 300-600 K, (b) serrated yielding from 453-600 K and an increasing work hardening rate from 300-600 K; scanning electron microscope studies show that failures were by microvoid coalescence at low temperatures changing to a predominantly intergranular mode in the embrittlement range. Study of the vanadium-oxygen system also showed an embrittlement region between 600-875 K. This embrittlement was accompanied by a yield stress plateau between 400-600 K, an increasing work hardening rate between 300-650 K and serrated yielding from 525 K to 650 K. A high level of titanium impurity limited testing to low oxygen concentrations. Tests on the tantalum-nitrogen system concluded that nitrogen did not produce slow strain-rate embrittlement in this metal although it served as a potent room temperature strengthener. The interval in which embrittlement is expected in this metal is at a sufficiently high temperature that dynamic recovery and softening take place. GRA

N81-11184# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
ROLE OF MICROSTRUCTURE IN HIGH TEMPERATURE OXIDATION Final Report, 1 Jan. 1977 - 31 Jan. 1980
F. N. Rhines, R. G. Connell, Jr., and M. S. Choi May 1980 177 p refs
(Grant DAAG29-77-G-0056; DAAG20-79-G-0051)
(AD-A090235; ARO-13968.2-MS) Avail: NTIS HC A09/MF A01 CSCL 11/6

The major objective of this research work was to study the influence of minor impurity elements present in nickel upon its oxidation behavior, specifically as regards the correlation between scale thickening and its concurrent microstructural evolution. Materials chosen for this work were Nickel 270 and a nickel of lower purity, Nickel 200. The Nickel 270 served as a standard of comparison for the oxidation behavior of Nickel 200. Initially the research activity was concentrated on a study of the microstructural evolution of the inner scale layer and the metal-oxide interface of Nickel 270. The results of this work combined with those of a previous research dealing with the outer scale layer formed a basis of comparison for the work on Nickel 200. A secondary study was made of the oxidation behavior of high purity copper in air at 800 C where the predominant oxide is CuO. The scale thickening and microstructural evolution of CuO formed under these conditions are similar to the oxidation behavior of nickel. GRA

N81-11185# Dayton Univ., Ohio.
A POISONING STUDY OF NICKEL MATRIX CATHODES Final Report
Thomas P. Graham 24 Jul. 1980 50 p refs
(Grant AF-AFOSR-0109-79)
(AD-A090036; AFOSR-80-0756TR) Avail: NTIS HC A03/MF A01 CSCL 09/1

The poisoning of nickel matrix cathodes by various gases has been investigated experimentally. The experiments were performed using conventional UHV techniques. The emission current was measured as a function of time for cathode temperatures between 750 C and 1000 C and poisoning gas pressures in the range from .00000001 torr to .00001 torr. Oxygen, carbon dioxide and carbon monoxide poison these cathodes. For a fixed cathode temperature and poisoning gas pressure, oxygen poisons the cathodes most severely, carbon dioxide less so and carbon monoxide the least. The rate of poisoning for any of the gases increases with increasing poisoning gas pressure and decreasing cathode temperature. The experiments indicate that the time for reactivation from the poisoned state depends upon the length of time the cathode remained in the poisoned state. The poisoning and reactivation data will be compared with theoretical models of the poisoning process.GRA

N81-11186# Pittsburgh Univ., Pa.
COMPUTERIZED POWDER METALLURGY P/M FORGING TECHNIQUES Final Report
Suresh Pillay and Howard Kuhn Sep. 1980 163 p refs
(Contract DAAA08-78-C-0013)
(AD-A090043; SARRI-EN-80-2) Avail: NTIS HC A08/MF A01 CSCL 11/6

Forging of sintered powder preforms is an attractive manufacturing alternative to conventional forging as it combines the cost and material saving advantages of conventional, press-and-sinter, powder metallurgy and the property enhancement of forging. The preforms contain a dispersion of voids, and forging of such materials into finished shapes must be accomplished such that no defects are formed and all residual porosity is eliminated. These objectives can be achieved through the proper design of the powder preform. The design currently is accomplished through a lengthy trial and error procedure. Empirical design rules have been established, from simple model experiments, to facilitate the proper design of preforms. Application of these rules to complex components requires an understanding of the behavior of porous materials with respect to densification, flow and fracture and the effects of die design, lubrication and temperature. An interactive computer-aided design approach was developed to facilitate the design and

evaluation of preforms. The design was accomplished in two phases. The first phase described the part to be forged together with a schematic subdivision of the part into regions. The second phase involved the specification of trial preform shapes for the part. The program evaluated the input shape for densification and non-aggravating metal flow. GRA

N81-11187# Rockwell International Corp., Thousand Oaks, Calif. Science Center.

MECHANISMS BY WHICH HUMIDITY ALTERS DUCTILITY Technical Report, 15 Apr. 1979 - 14 Apr. 1980

W. L. Morris, M. R. James, O. Buck, R. Chang, and J. W. Wert Aug. 1980 68 p refs

(Contract N00014-79-C-0334; NR Proj. 036-134)

(AD-A089827; SC5211.1TR) Avail: NTIS HC A04/MF A01 CSCL 11/6

The mechanical properties of a thin layer at the surface of aluminum alloys change progressively during fatigue. The alterations are more pronounced and rapid for fatigue in moist than in dry air. The alterations observed as a change in the ductility of the surface was characterized, and the rates of crack initiation, early growth and the relaxation of residual surface stresses during fatigue are all sensitive to the state of ductility of the surface was found. The depth into the surface affected by environment is too shallow to permit characterization of the surface ductility by conventional techniques. Five parameters, related to different aspects of surface ductility, are defined and methods to measure them are discussed. Results of an initial survey of the relationship of alloy type and heat treatment to the sensitivity of surface ductility to humidity are also described. GRA

N81-11188# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.

CORROSION OF HIGH Ni-Cr ALLOYS AND TYPE 304L STAINLESS STEEL IN HNO3-HF

R. S. Ondrejcin and B. D. McLaughlin Apr. 1980 46 p refs

(Contract DE-AC09-76SR-00001)

(DP-1550) Avail: NTIS HC A03/MF A01

Nineteen alloys were evaluated as possible materials of construction for steam heating coils, the dissolver vessel, and the off-gas system of proposed facilities to process thorium and uranium fuels. Commercially available alloys were found that are satisfactory for all applications. DOE

N81-11189# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.

FRACTOGRAPHY OF HYDROGEN-EMBRITTLED IRON-CHROMIUM-NICKEL ALLOYS

G. R. Caskey, Jr. 1980 17 p refs Presented at the 13th Ann. Tech. Meeting of the Intern. Metallog. Soc., Brighton, England, 18-22 Aug. 1980 Submitted for publication

(Contract DE-AC09-76SR-00001)

(DM-MS-80-19; CONF-800833-2) Avail: NTIS HC A02/MF A01

Tensile specimens of iron-chromium-nickel base alloys were broken in either a hydrogen environment or in air following thermal charging with hydrogen. Fracture surfaces were examined by scanning electron microscopy. Fracture morphology of hydrogen-embrittled specimens was characterized by: changed dimple size, twin boundary parting, transgranular cleavage, and intergranular separation. The nature and extent of the fracture mode changes induced by hydrogen varied systematically with alloy composition and test temperature. Initial microstructure developed during deformation processing and heat treating had a secondary influence on fracture mode. DOE

N81-11190# Sandia Labs., Albuquerque, N. Mex.

DETERMINATION OF THE SHEAR STRENGTH OF SHOCK COMPRESSED 6061-T6 ALUMINUM

J. R. Asay and L. C. Chhabildas 1980 15 p refs Presented at the Intern. Conf. on the Metallurgical Effects of High Strain Rate Deformation and Fabrication, Albuquerque, New Mex., 22 Jun. 1980

(Contract DE-AC04-76DP-00789)

(SAND-80-1300C; CONF-800641-6) Avail: NTIS HC A02/MF A01

The strength of 6061-T6 aluminum was assessed over the stress range of 8-40 GPa using velocity interferometry to measure reloading and unloading profiles from the initial shocked state. These results show that the shear stress which can be supported in the shocked state increases by about a factor of five over this range. This observation is in agreement with previous investigations. However, an important new observation is that a substantial increase in shear stress occurs during reloading, resulting in a well-defined elastic precursor. This result indicates a significant departure from the elastic-plastic model and suggests that softening occurs during initial shock compression. DOE

N81-11191# Oak Ridge National Lab., Tenn.

COMPARISON OF THE HIGH TEMPERATURE OXIDATION BEHAVIOR OF ZIRCALOY-4 AND PURE ZIRCONIUM

R. E. Pawel and J. J. Campbell 1980 28 p refs Presented at the 5th Intern. Conf. on Zirconium in the Nucl. Ind., Boston, 4 Aug. 1980

(Contract W-7405-eng-26)

(CONF-800834-1) Avail: NTIS HC A03/MF A01

Oxidation rate data for Zircaloy-4 in steam under isothermal conditions in the temperature range 1000-1500 C indicated that the kinetics of layer growth and oxygen consumption can be described by virtually ideal parabolic behavior. The growth of the two product phases, oxide and oxygen-stabilized alpha was presumed to be controlled by diffusion processes leading to uniform layer thickening. The oxidation rate of pure, arc-melted, crystal-bar zirconium was measured under similar conditions and differences in the reaction characteristics compared to Zircaloy-4 were found. Analysis of these data in terms of a multi-layer diffusion model suggested that the effective chemical diffusion coefficient for oxygen in the oxide phase was altered. However, despite the kinetic differences, the analysis also concluded that the diffusion coefficient of oxygen in the alpha layers was identical, a finding consistent with the results of independent measurements. DOE

N81-11192# Giner, Inc., Waltham, Mass.

STUDY OF ALUMINUM CORROSION IN ALUMINUM SOLAR HEAT COLLECTORS USING AQUEOUS GLYCOL SOLUTION FOR HEAT TRANSFER Semiannual Technical Progress Report, 30 Jul. 1979 - 31 Jan. 1980

D. Wong, F. H. Cocks, and J. Giner Feb. 1980 24 p refs

(Contract DE-AC04-79CS-31072)

(DOE/CS-31072/T1) Avail: NTIS HC A02/MF A01

The study of the effects of glycol aging at elevated temperatures is presented. Glycols are known to be susceptible to thermal decomposition producing new product species which may be aggressive to aluminum. In addition, the possible breakdown of corrosion inhibitors due to long term exposure to high temperature were also investigated. Both uninhibited and inhibited ethylene (as well as propylene) glycols were aged at temperatures up to 190 C for over 2000 h continuously. Aliquot samples of each glycol solution tested in this program were taken at 1000 and 2000 h of exposure for chemical analysis and pH measurement. Based on the data obtained so far, solution pH was found to decrease steadily with exposure time. The critical pitting potential of 1100 series aluminum in a 50 vol % aqueous ethylene glycol solution is reported as functions of both temperature and chloride ion concentration. This information is essential in the cathodic protection of pitting corrosion of aluminum. DOE

N81-11193# California Univ., Livermore. Lawrence Livermore Lab.

LIQUID-METAL EMBRITTLEMENT OF REFRACTORY METALS BY MOLTEN PLUTONIUM

D. R. Lesuer, J. B. Bergin, S. A. McInturff, and B. A. Kuhn Jul. 1980 26 p refs Presented at the 13th Ann. Tech. Meeting of the Intern. Metallog. Soc., Brighton, England, 18-20 Aug. 1980

(Contract W-7405-eng-48)

(UCRL-83986; CONF-800833-1) Avail: NTIS HC A03/MF A01

Embrittlement by molten plutonium of the refractory metals and alloys W-25 wt % Re, tantalum, molybdenum, and Ta-10 wt % W was studied. Embrittlement was found to exhibit a high degree of temperature and strain-rate dependence, and arguments that strongly support a stress-assisted, intergranular, liquid-metal

corrosion mechanism are presented. Microstructure plays a key role in the extent of embrittlement. In the case of W-25 wt % Re, it was determined that a dealloying corrosion takes place in which rhenium is selectively withdrawn from the alloy. DOE

N81-11194# Pennsylvania State Univ., University Park.
THEORETICAL ANALYSIS OF CARBON CLUSTER FORMATION IN SOLID IRON-BASED ALLOYS: A REVIEW OF THE ALEX-MCLELLAN MATHEMATICAL MODEL Interim Report
M. Small Aug. 1980 33 p refs
(EPRI Proj. 838-1)
(EPRI-AP-1478) Avail: NTIS HC A03/MF A01

Experimental results indicated that in the early stages of the carburization of iron alloys at moderately high temperatures carbon-rich clusters form around some solute atoms. A statistical thermodynamic model for metallic solutions containing interstitial species was examined. This model is outlined and discussed in detail, along with its application to an explanation of the results from the current study on the carburization of iron alloys containing chromium and molybdenum. DOE

N81-11195# Argonne National Lab., Ill.
MEASURED AND EVALUATED NEUTRON CROSS SECTIONS OF ELEMENTAL BISMUTH
A. B. Smith, P. Guenther, D. Smith, J. Whalen, and R. Howerton 1980 90 p refs
(Contract W-31-109-eng-38)
(ANL/NDM-51) Avail: NTIS HC A05/MF A01

Neutron total cross sections of elemental bismuth are measured with broad resolution from 1.2 to 4.5 MeV to accuracies of approximately 1 percent. Neutron differential elastic scattering cross sections of bismuth are measured from 1.5 to 4.0 MeV. Differential neutron cross sections for the excitation of observed states in bismuth at 895 + or - 12, 1606 + or - 14, 2590 + or - 15, 2762 + or - 29, 3022 + or - 21, and 3144 + or - 15 keV are determined at incident neutron energies up to 4.0 MeV. An optical-statistical model is deduced from the measured values. This model, the present experimental results, and information available elsewhere in the literature are used to construct a comprehensive evaluated nuclear data file for elemental bismuth in the ENDF format. The evaluated file is particularly suited to the neutronic needs of the fusion-fission hybrid designer. DOE

N81-11196# Bendix Corp., Kansas City, Mo.
CORROSION PROTECTION AND GALVANIC CORROSION PREVENTION FOR 7075 Al AND Ti-6Al-6V-2Sn ALLOYS Final Report
F. A. Clay Jul. 1980 31 p refs
(Contract DE-AC04-76DP-00613)
(BDX-613-2396) Avail: NTIS HC A03/MF A01

Titanium-to-aluminum coupling was investigated to determine the best method of minimizing galvanic corrosion problems. Sulfuric-acid-anodized and electroless-nickel-plated 7075 aluminum alloy panels successfully passed 96 hours of salt spray testing when galvanically coupled to duplex-annealed Ti-6Al-6V-2Sn alloy panels. Adherent paint deposits were produced on the titanium alloy and electroless nickel surfaces using a wash primer, an epoxy primer, and a urethane paint coating. A painted part survived 35 cycles of alternating salt spray and hot and freezing environments without blistering. A low chloride cutting fluid was selected for production machining of Ti-6Al-6V-2Sn, based on chemical analysis and stress-corrosion tests. A cleaning process was developed to remove both titanium and aluminum cutting fluids. Modified wedge-opening-loading specimens were used to verify that no stress-corrosion cracking problems occurred with the duplex-annealed Ti6Al-6V-2Sn alloy because of residual titanium or aluminum cutting fluids. DOE

N81-11197# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
INVESTIGATIONS OF INTERMETALLIC ALLOY HYDRIDING MECHANISMS Annual Progress Report, 1 May 1979 - 30 Apr. 1980
B. R. Livesay and J. W. Larsen 1980 169 p refs
(Contract DE-AS05-76ER-05246)
(DOE/ER-05246/4) Avail: NTIS HC A08/MF A01

The mechanisms involved with the hydrogen-metal interactions which control the absorption and desorption processes in intermetallic compounds are investigated. Modeling of hydride formation, microbalance investigations, microstructure investigations, flexure experiments, resistivity experiments, and nuclear backscattering measurements are discussed. These investigations concern fundamental hydrogen interaction mechanisms involved in storage alloys. DOE

N81-11198# General Atomic Co., San Diego, Calif.
INVESTIGATION OF SEVERAL COMMERCIAL ALUMINIDE COATINGS FOR CARBURIZATION PROTECTION OF A NICKEL-BASE ALLOY
G. Y. Lai Jun. 1980 24 p refs
(Contract DE-AT03-76ET-35300)
(GA-A-15825) Avail: NTIS HC A02/MF A01

Four commercial aluminide coatings applied to Hastelloy Alloy X were investigated with respect to their carburization resistance in a carburizing impure helium environment. The test gas was helium. The uncoated specimens exposed to this test environment at 900 C for 1000 and 2000 h exhibited significant carburization. All four coatings provided good protection against carburization of the substrate Hastelloy Alloy X, presumably due to the formation of an Al2O3 oxide scale on the coating surface during the high temperature corrosion exposure. Aluminide coatings applied to Hastelloy Alloy X exhibited a tendency for forming Kirkendall diffusion voids (or pores) in the diffusion zone during long term high temperature exposures. Chromium addition during aluminizing, which resulted in a high chromium content in the coating, appears to be effective in preventing the pore formation during subsequent long term high temperature exposures. DOE

N81-11199# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
J-CONTROLLED CRACK GROWTH AS AN INDICATION OF HYDROGEN-STAINLESS STEEL COMPATIBILITY
M. R. Dietrich (Babcock and Wilcox Research Center, Lynchburg, Va.), G. R. Caskey, Jr., and J. A. Donovan (Massachusetts Univ., Amherst) 1980 17 p refs Presented at 3d Intern. Conf. on Effects of Hydrogen on Mater., Jackson Lake Lodge, Wyo., 26 Aug. 1980
(Contract DE-AC09-76SR-00001)
(DP-MS-79-73; CONF-800850-1) Avail: NTIS HC A02/MF A01

The J-integral was evaluated as a parameter to characterize fracture of stainless steels and as a measure of hydrogen damage. C-shaped specimens of type 304L, 316, and 21-6-9 stainless steels were tested in high pressure helium and hydrogen. The critical force for crack initiation and tearing resistance were decreased by hydrogen in all three alloys. The J-integral appears useful as a measure of hydrogen compatibility because it is sensitive to both test environment and microstructure. DOE

N81-11200# Lehigh Univ., Bethlehem, Pa.
FRACTURE MECHANICS AND SURFACE-CHEMISTRY STUDIES OF STEELS FOR COAL-GASIFICATION SYSTEMS Final Technical Report, 17 Sep. 1976 - 31 Dec. 1979
R. P. Wei and G. W. Simmons May 1980 73 p refs
(Contracts DE-AS01-76ET-10647; DE-AS05-76OR-10647)
(IFSM-80-104) Avail: NTIS HC A04/MF A01

Fracture mechanics and surface chemistry experiments on the kinetics of fatigue crack growth, and on the thermodynamics and kinetics of surface reactions carried out on a 2-1/4Cr-1Mo steel are discussed. The results indicate considerable enhancement of fatigue crack growth by hydrogen sulfide, hydrogen, and water vapor. The degree of enhancement is related to the reactivity of these gases with the steel. Furthermore, the results indicate that the apparent immunity of this steel to stress corrosion cracking does not imply the same immunity to corrosion fatigue. The enhanced segregation of sulfur to free surfaces during heating in hydrogen is found. The crack growth data are discussed in terms of the influences of temperature, gas pressure, and loading variables, and are interpreted in terms of gas transport and chemical reaction kinetics. Quantitative modeling of environment enhancement and inhibition of fatigue crack growth is considered. Preliminary studies of fatigue crack growth in mixtures of H2S and CO indicate that CO reduces the effectiveness of H2S in enhancing crack growth. DOE

N81-11201# California Univ., Berkeley. Materials and Molecular Research Div.

ANNEALING BEHAVIOR OF HIGH PERMEABILITY AMORPHOUS ALLOYS M.S. Thesis

Lewellyn Rabenberg Jun. 1980 59 p refs

(Contract W-7405-eng-48)

(LBL-00995) Avail: NTIS HC A04/MF A01

Effects of low temperature annealing on the magnetic properties of the amorphous alloy Co71 4Fe4 6Si9 6B14 4 were investigated. Annealing this alloy below 400 C results in magnetic hardening; annealing above 400 C but below the crystallization temperature results in magnetic softening. Above the crystallization temperature the alloy hardens drastically and irreversibly. Conventional and high resolution transmission electron microscopy were used to show that the magnetic property changes at low temperatures occur while the alloy is truly amorphous. By imaging the magnetic microstructures, Lorentz electron microscopy was able to detect the pressure of microscopic inhomogeneities in this alloy. The low temperature annealing behavior of this alloy was explained in terms of atomic pair ordering in the presence of the internal molecular field. Lorentz electron microscopy was used to confirm this explanation. DOE

N81-11202# Ames Lab., Iowa.

SURFACE SELF-DIFFUSION OF VANADIUM Ph.D. Thesis

Jick Ming Yu 1980 110 p refs

(Contract W-7405-eng-82)

(IS-T-925) Avail: NTIS HC A06/MF A01

The decay of periodic profile on the surfaces of single crystalline vanadium specimen is orientation dependent. Faceting occurs on both (100) and (110) surfaces. Periodic profile becomes sinusoidal on the (111) surface and the sinusoidal profile becomes distorted on a surface 9 deg away from the (111) plane. The surface self diffusion coefficient of vanadium was determined by using Mullins' theory of sinusoidal profile decay on the (111) surface. The anisotropy indicates that the effect of ledges cannot be neglected. The experimental activation energy is lower than that calculated from the pairwise interaction model and the heat of sublimation. This difference is attributed to the fact that the model does not account for both the lattice relaxation and the electron redistribution at the surface. In general, the surface self diffusion coefficients of bcc refractory metals can be expressed as D(sub s) = 3.75 exp (-9.78 Tm/T) sq cm/sec. This expression predicts the diffusion coefficients to within a factor of two or three. DOE

N81-11203# California Univ., Berkeley. Materials and Molecular Research Div.

EFFECTS OF COMPOSITION AND HEAT TREATMENTS ON THE STRENGTH AND DUCTILITY OF Fe-Cr-Co ALLOYS Ph.D. Thesis

Kenneth G. Kubarych Jun. 1980 128 p refs

(Contract W-7405-eng-48)

(LBL-9941) Avail: NTIS HC A07/MF A01

The relationship between the microstructure and mechanical properties of spinodally decomposed Fe-Cr-Co ductile permanent magnet alloys was investigated using transmission electron microscopy, electron diffraction, tensile testing, and Charpy impact testing. Isothermal aging and step aging of four alloys resulted in decomposition into two phases, an Fe-Co rich alpha sub 1 phase and a Cr rich alpha sub 2 phase. The microstructural features of the decomposition products were consistent with those expected from a spinodal reaction and agree with the reported work on the Fe-Cr-Co system. An Fe-23 wt percent Cr-15 wt percent Co-5 wt percent V alloys was found to have among the four alloys, the best combinations of strength and ductility. DOE

N81-11204# Bendix Corp., Kansas City, Mo.

UNIFORM ALUMINUM DEPOSITS ON LARGE NONPLANAR AND PLANAR POLYIMIDE SUBSTRATES BY PHYSICAL VAPOR DEPOSITION

G. J. Hale Jul. 1980 29 p refs

(Contract DE-AC04-76DP-00613)

(BDX-613-2397) Avail: NTIS HC A03/MF A01

The capability to deposit 10 to 12 micrometers thick aluminum films with less than 2 percent thickness uniformity (defined as standard deviation/average thickness) on large nonplanar and planar polyimide substrates was developed using physical vapor deposition (PVD). A technique called shadow masking was developed to provide this consistent deposit uniformity over the entire substrate surfaces. The specific dimensions of a shadow mask for each substrate are generated from a computer reduced plot of beta backscatter thickness measurements of a previous deposit. With this developed method, initial thickness uniformities of 9.7 and 24.7 percent obtained for the nonplanar and planar deposits were improved to 1.07 and 1.80 percent, respectively. DOE

N81-11205# Battelle Columbus Labs., Ohio.

STUDY OF CORROSION IN MULTIMETALLIC SYSTEMS. TASK 2 OF SOLAR COLLECTOR STUDIES FOR SOLAR HEATING AND COOLING APPLICATIONS Final Technical Progress Report

Ronald B. Diegle 11 Apr. 1980 67 p refs

(Contract DE-AC04-79CS-10510)

(DOE/CS-10510/T9) Avail: NTIS HC A04/MF A01

Corrosion measurements were made on candidate alloys of construction for nonconcentrating solar collectors under simulated conditions of collector operation. Materials evaluated were aluminum alloys 1100, 3003, and 6061, copper alloy 122, Type 444 stainless steel, and 1018 plain carbon steel. The solutions used were equivolume mixtures of ethylene glycol and water, and propylene glycol and water. They were used without corrosion inhibitors but with addition of chloride, sulfate, and bicarbonate ions. The influences of dissolved oxygen, solution flow velocity, and heat transfer were evaluated. Corrosion morphologies investigated were general attack, pitting, crevice corrosion, and galvanic corrosion. During circulation at 100 C in the presence of air, ethylene glycol solutions acidified because of degradation of the glycol. The initial pH of propylene glycol solutions was already low, about 4.5. The inherent corrosivity of propylene glycol was somewhat less than that of ethylene glycol, although this difference was usually less than a factor of two in measured corrosion rates. It was concluded that the corrosion rates of aluminum alloys and copper were prohibitively high in uninhibited glycol solutions, and that corrosion inhibitors are definitely necessary in operating systems. DOE

N81-11206# Battelle Columbus Labs., Ohio.

CORROSION PROBLEMS WITH AQUEOUS COOLANTS, Final Report

R. B. Diegle, J. A. Beavers, and J. E. Clifford 11 Apr. 1980 224 p refs

(Contract DE-AC04-79CS-10510)

(DOE/CS-10510/T11) Avail: NTIS HC A10/MF A01

The results of a one year program to characterize corrosion of solar collector alloys in aqueous heat transfer media are summarized. The program involved a literature review and a laboratory investigation of corrosion in uninhibited solutions. It consisted of three separate tasks, as follows: review of the state of the art of solar collector corrosion processes: study of corrosion in multimetallic systems; and determination of interaction between different waters and chemical antifreeze additives. A comprehensive review of published literature concerning corrosion under solar collector operating conditions was undertaken. The corrosion behavior of candidate alloys was determined. The degradation rates of glycol based heat transfer media were measured and the effects of degradation on the corrosion behavior of metallic collector materials were evaluated. DOE

N81-11207# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.

STUDY TO OPTIMIZE Cr-Mo STEELS TO RESIST HYDROGEN AND TEMPER EMBRITTLEMENT Quarterly Report, 15 Nov. 1979 - 15 Feb. 1980

B. J. Shaw Jul. 1980 19 p refs

(Contract DE-AC01-78ET-13513)

(DOE/ET-13513/T2; Rept-80-9D9-HYTEM-R2; QR-6) Avail: NTIS HC A02/MF A01

A modified test technique was developed in this program to overcome difficulties in assessing the hydrogen embrittlement susceptibility of low strength 2 1/4 Cr-1 Mo steels. One steel sample was tempered to a range of strength levels and evaluated using the new technique. The results, showing a lower strength

level for which hydrogen embrittlement susceptibility can be assessed in a 446 KPa H2S environment, are presented. A review of the restructuring of the program is also given. DOE

N81-11208# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
SLIDING WEAR TOUGHNESS AND MICROSTRUCTURAL RELATIONSHIPS IN HIGH STRENGTH Fe/Cr/C EXPERIMENTAL STEELS M.S. Thesis
William J. Salesky Jun. 1980 79 p refs
(Contract W-7405-eng-48)
(LBL-10994) Avail: NTIS HC A05/MF A01

Hardness is the major parameter influencing wear resistance of materials. Combinations or high strength and toughness may lead to optimum wear resistance. The martensite transformation can be exploited to provide a variety of strength-toughness combinations. Small additions of Mn or Ni to the Fe/4Cr/.3C martensitic alloys increase toughness while maintaining strength via increasing the volume fraction of retained austenite. An investigation of the relationships between microstructure, toughness, and sliding wear resistance for these experimetnal alloys is reported. Comparative studies were performed on several industrial alloys to provide a practical basis for comparison of these medium carbon experimental steels. DOE

N81-11209# California Univ., Livermore. Lawrence Livermore Lab.
PLATING ON DIFFICULT-TO-PLATE METALS: WHAT'S NEW
Harold J. Wiesner 30 Jul. 1980 22 p refs Presented at the Plating on Difficult-to-Plate Metals Symp., New Orleans, 30-31 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-84440; CONF-801031-1) Avail: NTIS HC A02/MF A01

Some of the changes since 1970 in procedures for plating on such materials as titanium, molybdenum, silicon, aluminum, and gallium arsenide are summarized. While basic procedures for plating some of these materials were developed as many as 30 to 40 years ago, changes in the end uses of the plated products have necessitated new plating processes. In some cases, vacuum techniques - such as ion bombardment, ion implantation, and vacuum metallization - were introduced to improve the adhesion of electrodeposits. In other cases, these techniques were used to deposit materials upon which electrodeposits are required. DOE

N81-11210# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
HIGH-TEMPERATURE OXIDATION AND CORROSION OF MATERIALS PROGRAM
David P. Whittle Mar. 1980 32 p refs
(Contract W-7405-eng-48)
(LBL-11202) Avail: NTIS HC A03/MF A01

The behavior of metals and alloys in gas mixtures at high temperature was studied with emphasis on the following: corrosion mechanisms in complex environments of low oxidizing potential; hot corrosion of nickel base alloys at intermediate temperatures; corrosion of solid sulfate deposits, adherence of Al2O3 oxide films; oxidation behavior of a two phase alloy Fe-44 percent Cu; and formation of subscales of varying composition. DOE

N81-11211# California Univ., Livermore. Lawrence Livermore Lab.
COMPARISON ASSAY OF A GOLD PLATING SOLUTION BY CONTROLLED-POTENTIAL COULOMETRY AND FIRE ASSAY
J. E. Harrar, M. C. Waggoner, and J. W. Loy 7 Aug. 1980 9 p refs
(Contract W-7405-eng-48)
(UCID-18766) Avail: NTIS HC A02/MF A01

A commercial gold-electroplating solution was assayed for its total gold content by two high-precision techniques and the results were compared. The solution was analyzed using controlled-potential coulometry and by the fire assay technique agreement was within 0.3% for the total quantity of gold in two containers that were sampled, and within 0.5 to 1.0% for the concentrations of gold in the solutions. DOE

N81-11212# Terra Tek, Inc., Salt Lake City, Utah.
DATA ANALYSIS METHODS FOR SHORT ROD AND SHORT BAR FRACTURE TOUGHNESS TESTS OF METALLIC MATERIALS
L. M. Barker Mar. 1980 39 p refs
(Grant NSF DAR-78-20993)
(PB80-205685; TR-80-12; NSF/RA-800078) Avail: NTIS HC A03/MF A01 CSCL 11F

The behavior of short rod and short bar metallic specimens when measured for plane strain fracture toughness is described. Such measurements are of increasing interest due to a simplicity of specimen design, small specimen size, automatic creation of a natural precrack without fatigue, and the accuracy and reproducibility of test results. The report describes four basic behavior types and the procedures used for data analysis. Most materials have a relatively smooth crack during testing but some, including many steels, exhibit a jump behavior which requires a different procedure. Specimen geometry, test procedures, and data analysis methods combine to provide good measurements of the plane strain fracture toughness even in the presence of macroscopic stresses and limited plasticity during the test. Criteria for judging the validity of test procedures are presented. GRA

N81-11982*# Alabama Univ. in Huntsville. Dept. of Physics.
ION PLATING STUDIES FOR HIGH TEMPERATURE APPLICATIONS
Jack H. Davis *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 17 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 11F

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N81-11213 Utah Univ., Salt Lake City.
SURFACE CHARACTERIZATION OF SYNTHETIC POLYMERS FOR BIOMEDICAL APPLICATIONS Ph.D. Thesis
Robert Norman King 1980 189 p
Avail: Univ. Microfilms Order No. 8025294

Three areas of characterization, surface energetics, surface chemistry, and the electrical nature of the surface were investigated. The surface energetics of a prepared series of methacrylate ester copolymers with controlled hydrophilic/hydrophobic properties were investigated and characterized in equilibrium with water and other aqueous solutions. The interfacial free energy of these systems drops rapidly to essentially zero when the water content of the gel network approaches 30 wt percent and above, suggesting a possible molecular rearrangement in the surface region which minimizes the interfacial free energy. The surface chemistry of pyrolytic carbon was investigated using the technique of X-ray photoelectron spectroscopy. At least three types of carbon oxygen functional groups are present on the polished surface of pyrolytic carbon. The literature on the surface chemistry of carbon is reviewed and the data are discussed in terms of the potential role of these surface functional groups in determining biocompatibility. Electrokinetic data determined for the charge copolymers showed a maximum range of zeta potential from -50 mV to +10 mV. Dissert. Abstr.

N81-11214*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POLYTETRAFLUOROETHYLENE TRANSFER FILM STUDIED WITH X-RAY PHOTOELECTRON SPECTROSCOPY
Donald R. Wheeler Nov. 1980 11 p refs
(NASA-TP-1728; E-414) Avail: NTIS HC A02/MF A01 CSCL 11G

Polytetrafluoroethylene (PTFE) was rubbed against nickel in ultrahigh vacuum at loads up to 3.9 N and speeds up to 94 mm/sec. The transfer film formed on the nickel was analyzed using X-ray phototectron spectroscopy. The film was indistinguishable from bulk PTFE except for the possible presence of a small amount of NiF2. The transfer film was found to be about 1 molecule (0.5 nm) thick under all conditions; but at speeds

above 10 mm/sec, there was evidence of bulk transfer in the form of fragments as well. The thickness measurements required a choice among conflicting published values of the inelastic mean free path for electrons in polymers. The values chosen gave internally consistent results. Author

N81-11215# Ford Motor Co., Dearborn, Mich. Ceramic Materials Dept.
CERAMIC LIFE PREDICTION PARAMETERS Progress Report, 1 Jan. 1977 - 31 Mar. 1980
R. K. Govila May 1980 140 p refs
(Contract DAAG46-77-C-0028)
(AD-A090272; AMMRC-TR-80-18) Avail: NTIS HC A07/MF A01 CSCL 11/2

This program consisted of a basic study using two potential high temperature ceramic materials, hot-pressed silicon nitride, NC-132 (NORTON), and hot-pressed silicon nitride made with 3.5 wt. percent MgO (Ford material) to establish a statistical strength data base for fast fracture as well as for the presence of subcritical crack growth. The Weibull characteristic strength and modulus were determined. Among the fracture mechanics approach, the primary experimental techniques were double-torsion and indentation-induced flaw methods to determine the relationship between crack velocity, V, and stress intensity, K, during subcritical crack growth for Nc-132 Si3N4. The subcritical crack growth exponent 'n' was determined using flexural stress and strain rate methods and stress rupture methods, and showed a wide scatter in magnitude. When all the relevant life prediction parameters such as inherent flaw size, strength, critical stress intensity factor, and K-V relationship for slow crack growth are known, an estimate of time-to-failure for a given applied stress, temperature and environment can be made using the numerical relationships outlined by Evans and Wiederhorn earlier. Care should be taken in selecting the appropriate parameters since these parameters are a function of evaluation technique, otherwise the predicted time-to-failure will show a large variation. GRA

N81-11216# Florida Univ., Gainesville. Ceramics Div.
STRUCTURE-PROPERTY-ENVIRONMENTAL RELATIONS IN GLASS AND GLASS CERAMICS Final Report, 1 Mar. 1977 - 29 Feb. 1980
L. L. Hench Mar. 1980 147 p refs
(Grant AF-AFOSR-3210-77; AF Proj. 2303)
(AD-A089943; AFOSR-80-0775TR) Avail: NTIS HC A07/MF A01 CSCL 11/2

The overall objective of this study of glass, glass-ceramics, Si3N4 and SiC is aimed at developing predictive relationship for the lifetime of materials under various combinations of chemical, mechanical, and thermal environments. Several analytical surface techniques are now being routinely applied to the characterization of glass and glass surfaces. A clearer understanding of corrosion mechanisms and kinetics emerges when a combination of surface and solution analyses is employed. Glass corrosion mechanisms and kinetics, plus analytical techniques and testing methods used for measuring glass corrosion have been reviewed. GRA

N81-11217# SRI International Corp., Menlo Park, Calif.
SYNTHESIS OF ENERGETIC POLYMERS Summary Report, 15 Jul. 1979 - 14 Jul. 1980
J. M. Guimont, G. E. Manser, and D. L. Ross 15 Aug. 1980 29 p refs
(Contract N00014-79-C-0525; NR Proj. 093-063; SRI Proj. PYU-8627)
(AD-A089948) Avail: NTIS HC A03/MF A01 CSCL 07/3

During this first year of the program, three general synthetic routes to the preparation of energetic oxetanes and tetrahydrofurans were investigated. Efforts to develop a general synthetic route to 3-nitroalkly-substituted oxetanes starting with methylene malonate were not successful. However, one specific oxetane monomer was prepared to provide an immediate subject for polymerization studies. GRA

N81-11218# Princeton Univ., N. J. Polymer Materials Program.
RUBBER-MODIFIED EPOXIES: TRANSITIONS AND MORPHOLOGY Technical Report, Sep. 1979 - Sep. 1980
L. T. Manzione, J. K. Gillham, and C. A. McPherson 1 Sep. 1980 36 p refs Submitted for publication
(Contract N00014-76-C-0200; NR Proj. 356-504)
(AD-A090175; TR-19) Avail: NTIS HC A03/MF A01 CSCL 11/9

A variety of different morphologies, and therefore mechanical properties, can be obtained from a single rubber-modified epoxy formulation. The volume fraction, domain size, and the number of particles of phase-separated rubber are determined by the competing effects of incompatibility, rate of nucleation and domain growth, and the quenching of morphological development by gelation. These factors can be varied by the butadiene/acrylonitrile ratio of the reactive rubber, the temperature of cure and the gelation time. These ideas have been exploited to control the development of morphology of these amorphous systems. Phase separation was investigated by electron microscopy, viscometry, and dynamic mechanical analysis. GRA

N81-11219# Princeton Univ., N. J. Polymer Materials Program.
RUBBER-MODIFIED EPOXIES: MORPHOLOGY MECHANICAL PROPERTIES Technical Report, Sep. 1979 - Sep. 1980
L. T. Manzione and J. K. Gillham Sep. 1980 28 p refs
(Contract N00014-76-C-0200; NR Proj. 356-504)
(AD-A090122; TR-20) Avail: NTIS HC A03/MF A01 CSCL 11/10

A wide spectrum in morphology paralleling a range of phase-separated and dissolved rubber, can be developed in rubber-modified epoxies through control of rubber-epoxy compatibility and cure conditions. These morphologies result in different stress response mechanisms. Dissolved rubber promotes plastic deformation and necking at low strain rates that provide large increases in the elongation to break. Dissolved rubber is ineffective in providing improvement at impact rates. Phase-separated rubber domains can also increase the elongation to break since they promote cavitation at the interfacial boundary. The elongation is limited to the extent of cavitation and therefore large increases in the energy to break are not found. The presence of rubber domains was found to be a necessary but not sufficient condition for impact energy improvement. Optimum materials contained a relatively large amount of dissolved rubber and a low volume fraction of phase separated rubber. These combine high elongations at low strain rates with improved impact properties. GRA

N81-11220# Swedlow, Inc., Garden Grove, Calif.
DETERMINE THE FEASIBILITY OF FABRICATING POLYPROPYLENE SPHERICAL ARMOR RADOMES FOR PROTECTION FROM A LEVEL 2 FRAGMENTATION THREAT Final Report
G. Cook 30 Aug. 1980 34 p refs
(Contract N00173-79-C-0266)
(AD-A089740; SI-ER-915-FR) Avail: NTIS HC A03/MF A01 CSCL 17/9

This program has as its objective the determination of the feasibility of fabricating polypropylene armor radomes. These radomes are required to provide protection for radar antennas from a Level II fragmentation threat. Four inch thick PP armor will be required to meet this threat level. The plan was to develop processes based on the present state-of-the-art technology to fabricate four inch thick spherical radome sections, and to investigate edge-to-edge joining of flat polypropylene armor panels. The thick spherical molding is beyond the present technology and will require a new tooling and production approach. The present technology is limited to one inch thick flat panels. The manufacture of several four inch thick radome shell sections with a 60 inch spherical radius established the feasibility of this approach. These panels were submitted to the Naval Research Laboratory for performance evaluation. Adhesive and fusion bonded edge-to-edge joining methods were also developed. The systems evaluated indicate the feasibility of obtaining structural joints of PP armor panels. GRA

N81-11221# Midwest Research Inst., Golden, Colo. Materials Research Branch.
POLYMERS IN SOLAR TECHNOLOGIES: AN R AND D STRATEGY
William F. Carroll (Jet Propulsion Lab.) and Paul Schissel Jul.

1980 37 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-334-601) Avail: NTIS HC A03/MF A01

A five year program consisting of 20 tasks categorized into six major problem areas are presented. These are: response to combined stresses, photochemistry permeability adhesion; surface properties; mechanical properties; and development of polymers. A budget required for each task is estimated and summarized for each problem area. The potential future impact of polymers on the economics of solar technologies is shown to justify the proposed expenditures. DOE

N81-11222# Ames Lab., Iowa. Dept. of Chemistry.
CHELATING ION EXCHANGE WITH MACRORETICULAR HYDROXAMIC ACID Ph.D. Thesis
Richard James Phillips 1980 154 p refs
(Contract W-7405-eng-82)
(IS-T-910) Avail: NTIS HC A08/MF A01

The synthesis, reactions, and analytical applications of hydroxamic acids, including chelating resins with this functional group, are reviewed. A procedure for attaching N-phenyl hydroxamic acid groups to Amberlite XAD-4 is described. The extraction of 20 metal ions from 2 M hydrochloric acid by this resin is discussed. Conditions for the quantitative extraction and back extraction of 9 ions are reported. Results are compared with work on solvent extraction with N-phenylbenzohydroxamic acid. The scope of applications for hydroxamic acid resins is investigated by studying the extraction of 19 metal ions as a function of pH. The resins are especially suitable for the extraction of zirconium(IV), titanium(IV), and uranium(IV) from strongly acidic solution. Aluminum(III) is separated from calcium and phosphate by extraction at pH 4. The use of the resins for the purification of reagents, concentration of trace constituents, and chromatographic separation is demonstrated. DOE

N81-11223# Illinois Univ., Urbana. The Graduate Coll.
SEGMENT DENSITY FUNCTIONS OF POLYMER CHAINS CONFINED BY ABSORBING OR REFLECTING BARRIERS M.S. Thesis
Martin Jay Paisner Jul. 1980 59 p refs
(Contract DE-AC02-76ER-01198; Grant NSF DMR-76-21623)
(DOE/ER-01198/T1) Avail: NTIS HC A04/MF A01

A theoretical investigation into the segment density profile of confined chains is presented. The confinement is between a pair of infinite parallel walls which are reflecting or absorbing. Exact infinite series expressiona are derived for the segment density functions of cilia, loops, bridges, and floating chains. These infinite series are easily evaluated numerically. DOE

N81-11224# Illinois Univ. at Urbana-Champaign. Physics Research Lab.
ELECTRON PARAMAGNETIC RESONANCE STUDIES OF BETA-ALUMINA, A PROTOTYPE GLASS Ph.D. Thesis
Steven Ross Kurtz 1980 145 p refs
(Contract DE-AC02-76ER-01198)
(DOE/ER-01198/134) Avail: NTIS HC A07/MF A01

Electron paramagnetic resonance techniques were used to study single crystal Na, K, and Li beta-alumina. Color centers were introduced into this material by irradiating the samples with electrons at liquid nitrogen temperature. Using electron paramagnetic resonance and electron nuclear double resonance, the color centers generated in this manner were identified, and their location within the material were determined. For one of these centers the electron spin relaxation rate was measured over the range 2 to 20 K using the pulse saturation and recovery technique. These measurements revealed an exceptionally fast relaxation rate with anomalous temperature and microwave frequency dependence. Beta-alumina is a structurally unique system. It is partially disordered and consists of ordered blocks of aluminum oxide separated by planar disordered regions. DOE

N81-11225# Sandia Labs., Albuquerque, N. Mex.
HYDROGEN-FOR-LITHIUM EXCHANGE IN LITHIUM ALUMINOSILICATE CERAMICS. 1. MICROCRACKING
Howard McCollister and Lawrence H. VanVlack 1980 40 p refs Presented at the 33rd ACS Pacific Coast Meeting, San Francisco, 28 Oct. 1980 Prepared in cooperation with Michigan Univ., Ann Arbor
(Contracts NAS3-19733; DE-AC04-76DP-00789)
(SAND-89-1838C; CONF-801034-1) Avail: NTIS HC A03/MF A01

Lithium aluminosilicate ceramics were altered by acid. Hydrogen was exchanged for lithium in both keatite and high quartz type materials. The crystal structures of the lithium and hydrogen aluminoscilicates are isomorphous, but the cells of the latter are smaller. Thus, the H for Li exchange introduced microcracks. These permitted an ingress of acid to the reaction interface and established a linear reaction rate. This H for Li exchange follows the Arrhenius relationship between log reaction depth and reciprocal temperature. DOE

N81-11226# California Univ., Riverside. Dept. of Physics.
MUON SPIN ROTATION AND OTHER MICROSCOPIC PROBES OF SPIN-GLASS DYNAMICS
D. E. MacLaughlin 1980 9 p refs Presented at the 2d Intern. Topical Meeting on Muon Spin Rotation, Vancouver, British Columbia, Aug. 1980 Prepared in cooperation with LASL
(Contract W-7405-eng-36)
(LA-UR-80-2372; CONF-800855-7) Avail: NTIS HC A02/MF A01

A number of different microscopic probe techniques were employed to investigate the onset of the spin glass state in dilute magnetic alloys. Among these are Moessbauer effect spectroscopy, neutron scattering, electron spin resonance of the impurity spins, host nuclear magnetic resonance and, most recently, muon spin rotation and depolarization. Spin probes yield information on the microscopic static and dynamic behavior of the impurity spins, and give insight into both the spin freezing process and the nature of low-lying excitations in the ordered state. Microscopic probe experiments in spin glasses are surveyed, and the unique advantages of muon studies are emphasized. DOE

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N81-11227 Utah Univ., Salt Lake City.
CHARACTERIZATION OF COAL-DERIVED LIQUIDS RELATIONSHIPS TO CHEMICAL STRUCTURES IN COAL Ph.D. Thesis
Kwang Eun Chung 1980 164 p
Avail: Univ. Microfilms Order No. 8025596

The fundamental structural features of a high volatile bituminous coal were investigated by characterizing the liquid products derived from it. The structural features were described quantitatively in terms of heterogeneity, aromaticity, aromatic cluster size and polymeric nature. A scheme for characterization of coal-derived liquid (CDL) was developed based upon available information on coal and CDL. Three CDL's were prepared and characterized according to the scheme. The CDL's were produced in high conversion processes differing in the degree of depolymerization. The characterization of the three CDL's revealed (1) conservation of aromatic clusters during two liquefaction processes, (2) a definite distribution of aromatic clusters in the feed coal, and (3) some polymeric nature of the feed coal materials. Dissert. Abstr.

N81-11228*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
EXPERIMENTAL EVALUATION OF COMBUSTOR CONCEPTS FOR BURNING BROAD PROPERTY FUELS Final Report
J. M. Kasper, E. E. Ekstedt, W. J. Dodds, and M. W. Shayeson Sep. 1980 171 p refs
(Contract NAS2-21594)
(NASA-CR-159855; R80AEG514) Avail: NTIS HC A08/MF A01 CSCL 21I

A baseline CF6-50 combustor and three advanced combustor designs were evaluated to determine the effects of combustor

design on operational characteristics using broad property fuels. Three fuels were used in each test: Jet A, a broad property 13% hydrogen fuel, and a 12% hydrogen fuel blend. Testing was performed in a sector rig at true cruise and simulated takeoff conditions for the CF6-50 engine cycle. The advanced combustors (all double annular, lean dome designs) generally exhibited lower metal temperatures, exhaust emissions, and carbon buildup than the baseline CF6-50 combustor. The sensitivities of emissions and metal temperatures to fuel hydrogen content were also generally lower for the advanced designs. The most promising advanced design used premixing tubes in the main stage. This design was chosen for additional testing in which fuel/air ratio, reference velocity, and fuel flow split were varied. Author

N81-11229*# Aerojet Liquid Rocket Co., Sacramento, Calif.
COMBUSTION PERFORMANCE AND HEAT TRANSFER CHARACTERIZATION OF LOX/HYDROCARBON TYPE PROPELLANTS Interim Report
R. S. Gross Aug. 1980 146 p refs
(Contract NAS9-15958)
(NASA-CR-160874) Avail: NTIS HC A07/MF A01 CSCL 21I

A sound data base was established by analytically and experimentally generating basic regenerative cooling, combustion performance, combustion stability, and combustion chamber heat transfer parameters for LOX/HC propellants, with specific application to second generation orbit maneuvering and reaction control systems (OMS/RCS) for the Space Shuttle Orbiter. R.K.G.

N81-11230# Committee on Agriculture, Nutrition, and Forestry (U. S. Senate).
USDA GASOHOL RESEARCH ACTIVITIES OF PILOT PROJECTS
Washington GPO 1979 158 p refs Hearing before the Subcomm. on Agr. Res. and Gen. Legislation of the Comm. on Agr., Nutr., and Forestry, 96th Congr., 1st Sess., 23 Jul. 1979
(GPO-52-283) Avail: Subcommittee on Agricultural Research and General Legislation

The potential of developing alternative sources of energy from farm products and wood is discussed. Emphasis is placed on converting low grade hardwoods, wastewood, and cull wood, which is wood that will never be merchantable, to methanol, alcohol, and gas. R.K.G.

N81-11231# Committee on Commerce, Science, and Transportation (U. S. Senate).
AUTOMOBILE FUEL ECONOMY AMENDMENTS OF 1979
Washington GPO 1980 99 p Hearing on S. 1583, S. 2010 and S. 2035 before the Comm. on Com., Sci., and Transportation, 96th Congr., 2nd Sess., 23 Jan. 1980
(GPO-58-783) Avail: Committee on Commerce, Science, and Transportation

The Senate hearings before the Committee on Commerce, Science, and Transportation concerning amendments to the Motor Vehicle Information and Cost Savings Act are presented. Two of the amendments hold promise of added employment opportunity, or job preservation in some segments of the automobile industry. One amendment provides added flexibility for industry planning, which may serve to reduce the cost of compliance with fuel economy standards. Another amendment eliminates several provisions of fuel economy regulation from a sector of the automobile industry wherein experience has shown that such regulation is nonproductive. M.G.

N81-11232# Committee on Energy and Natural Resources (U.S. Senate).
SYNTHETIC FUELS LEGISLATION
Washington GPO 1980 411 p refs Hearings on S. 932, S. 1308 and S. 1377 before the Comm. on Energy and Nat. Resources, 96th Congr., 1st Sess., 23-24 Jul. 1979
(GPO-58-320; Publ-96-88) Avail: Committee on Energy and Natural Resources

The Senate hearings before the Committee on Energy and Natural Resources concerning synthetic fuels legislation are presented. An act to extend the Defense Production Act of 1950 to include a greater emphasis on developing energy independence is discussed. Also, a bill to set forth a national program for the full development of energy supply, in addition to a bill to establish a synthetic fuels and alternative fuels production authority are examined. M.G.

N81-11233# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
TOXICITY OF SYNTHETIC HIGH DENSITY AND CONVENTIONAL HYDROCARBON JET FUELS TO A SOIL BACTERIUM Technical Report, Sep. 1978 - Sep. 1979
Sheldon A. London and Charlie R. Mantel Aug. 1980 22 p refs
(AF Proj. 6302)
(AD-A089527; AFAMRL-TR-80-105) Avail: NTIS HC A02/MF A01 CSCL 06/20

The effects of selected high density and conventional jet fuels on the growth kinetics of a soil microorganism were determined. A culture of Enterobacter clocacae isolated from soil was exposed to various concentrations of each fuel in a mineral salts medium and bacterial growth was monitored turbidimetrically and by viable count techniques. Effects were indicated by observing changes in maximum bacterial growth, growth rate, lag time, and death rate. The majority of the fuels studied manifested their effects by decreasing the number of viable organisms during the stationary growth period. Stable emulsion formation resulted in erroneous turbidimetric determinations. The applicability of bacterial systems as indicators of toxicity of water insoluble jet propellants was discussed. GRA

N81-11234# Ohio State Univ., Columbus.
STUDIES ON THE CONVERSION OF PENTABORANE (9) TO DECABORANE (14), PART 2
Sheldon G. Shore, Francis L. Himpsl, and Mark A. Toft Sep. 1980 7 p
(Grant DAAG29-78-G-0112)
(AD-A089957; ARO-15611.5-C) Avail: NTIS HC A02/MF A01 CSCL 07/3

This report describes efforts toward the preparation of B10H14 from B5H9. A simpler procedure was developed for the preparation of B10H14. While yields of B10H14 to date are in the 30-35% range the method is significantly cleaner than the procedures described earlier. The use of cheaper reagents for the preparative procedure was investigated and it was found that NaH can be substituted for KH, N(CH3)4(-), can be substituted for N(n-C4H9)4(-), and BCl3 can be substituted for BBr3. GRA

N81-11235# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
INVESTIGATION OF FIRE-VULNERABILITY-REDUCTION EFFECTIVENESS OF FIRE-RESISTANT DIESEL FUEL IN ARMORED VEHICULAR FUEL TANKS Final Report, 25 Sep. 1979 - 30 Sep. 1980
B. R. Wright and W. D. Weatherford, Jr. 30 Sep. 1980 41 p refs
(Contract DAAK70-79-C-0215; DA Proj. 1L7-62733-AH-20)
(AD-A090129; AFLRL-130) Avail: NTIS HC A03/MF A01 CSCL 21/4

Laboratory flammability tests and bench-scale ballistic tests are described which have been used in the development of fire-resistant diesel fuel (FRF). These tests have indicated that FRF, at a bulk liquid temperature of 77 C, would be self extinguishing even if the flash point of its base fuel was less than 62 C. In order to confirm that this self-extinguishing property would prove effective in a realistic combat environment, arrangements were made for a series of tests to be conducted. These tests used 3.2 inch precision shaped charges fired through the armor and internally mounted fuel tanks of M48 battle tank and M113 armored personnel carrier hulks. AFLRL personnel participated in the planning and conducting of the tests, including all FRF blending. Results of the full-scale tests confirmed that residual burning can be eliminated by the use of FRF even though the mist fireball development is similar to that of neat fuel. Transient pressure effects are not affected by FRF, but sustained temperatures are drastically reduced by the FRF self-extinguishment. GRA

N81-11236# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
ENGINE TESTS USING HIGH-SULFUR DIESEL FUEL Final Report

E. A. Frame and R. B. Moon Sep. 1980 112 p refs
(Contract DAAK70-79-C-0215; DA Proj. 1L7-62733-AH-20)
(AD-A090142; AFLRL-129) Avail: NTIS HC A06/MF A01 CSCL 21/4

This report covers the engine test evaluation of an organo-zinc additive for its effectiveness in combating the deleterious effects of using high-sulfur diesel fuel in a two-cycle U.S. Army diesel engine. The report also covers the 6V-53T testing of a preservative engine oil which in previous testing had shown promise in controlling the effects of using high-sulfur fuel. GRA

N81-11237# Science Applications, Inc., McLean, Va.
TECHNICAL-ECONOMIC ASSESSMENT OF THE PRODUCTION OF METHANOL FROM BIOMASS: EXECUTIVE SUMMARY, VOLUME 1 Final Research Report
Edward I. Wan, John A. Simmons, Joseph D. Price, and Tien D. Nguyen 12 Jul. 1979 27 p 3 Vol.
(Contract ET-78-C-01-3002)
(DSE-3002-T1-Vol-1) Avail: NTIS HC A03/MF A01

The results are presented of a comprehensive systems study which assessed the engineering and economic feasibilities of the production of methanol from biomass utilizing existing technology. The three major components of the biomass to methanol system assessed are the availability of biomass feedstocks, the thermochemical conversion of biomass to methanol fuels, and the distribution and markets for methanol fuels. The results of this study show that methanol fuel can be produced from biomass using commercially available technology in the near term, and could be produced economically in significant quantities in the mid to late 1980's when advanced technology is available. DOE

N81-11238# Science Applications, Inc., McLean, Va.
TECHNICAL-ECONOMIC ASSESSMENT OF THE PRODUCTION OF METHANOL FROM BIOMASS. ASSESSMENT OF BIOMASS RESOURCE AND METHANOL MARKET, VOLUME 2 Final Research Report
Edward I. Wan, John A. Simmons, Joseph D. Price, and Tien D. Nguyen 12 Jul. 1979 70 p refs 3 Vol.
(Contract ET-78-C-01-3002)
(DSE-3002-T1-Vol-2) Avail: NTIS HC A04/MF A01

Detailed information is presented on the following: feasibility of biomass feedstocks for methanol production; biomass availability and costs; potential demand for methanol from biomass; comparison of potential methanol demand and supply; and market penetration assessment. DOE

N81-11239# Science Applications, Inc., McLean, Va.
TECHNICAL ECONOMIC ASSESSMENT OF THE PRODUCTION OF METHANOL FROM BIOMASS. CONVERSION PROCESS ANALYSIS, VOLUME 3 Final Research Report
Edward I. Wan, John A. Simmons, Joseph D. Price, and Tien D. Nguyen 12 Jul. 1979 353 p refs 3 Vol.
(DSE-3002-T1-Vol-3) Avail: NTIS HC A16/MF A01

Various thermochemical processes suitable for converting biomass to methanol are discussed. The results of the conversion process study are presented, delineating the technical and economic feasibilities of producing methanol fuel from biomass utilizing available technologies. DOE

N81-11240# Mueller Associates, Inc., Baltimore, Md.
SOLID FUEL APPLICATIONS TO TRANSPORTATION ENGINES
Richard L. Rentz and Roy A. Renner Jun. 1980 76 p refs
(Contract DE-AC05-79CS-56051)
(DOE/CS-56051/T2) Avail: NTIS HC A05/MF A01

The utilization of solid fuels as alternatives to liquid fuels for future transportation engines is reviewed. With respect to diesel engines, coal/oil mixtures are addressed because of the high interest in this specific application as a result of the large number of diesel engines currently in transportation use. Final assessments refer to solid fuels only for diesel engines. The technical assessments of solid fuels utilization for transportation engines is summarized. DOE

N81-11241# Los Angeles-Orange County Metropolitan Area Project, Whittier, Calif.
DEFLAGRATION-TO-DETONATION TRANSITION IN GRANULAR HMX
A. W. Campbell 1980 32 p refs
(Contract W-7405-eng-36)
(LA-UR-80-2016) Avail: NTIS HC A03/MF A01

The deflagration to detonation transition (DDT) in chemical explosives, specifically, granular HMX, is reviewed. The picture of the DDT process as presented here results from an attempt to incorporate common experimental observations which have heretofore been puzzling. The role of convective combustion is terminated and mechanical processes are postulated as the means of continuing the reaction buildup until shock waves are formed. In order to validate this picture it will be necessary both to review the experimental literature for observations which may not be reconcilable with it, and to subject each step in the proposed DDT process to detailed scrutiny. DOE

N81-11242# Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. Development Div.
SKID TEST SENSITIVITY OF CAST COMPOSITION B-3 AT AMBIENT AND LOW TEMPERATURES
Jim A. Crutchmer Jul. 1980 6 p
(Contract DE-AC04-76DP-00487)
(MHSMP-80-35) Avail: NTIS HC A02/MF A01

The skid test sensitivity of composition B-3 was determined using 10 kg billets at ambient and -30 C. The results indicate that the cold parts are slightly less sensitive than those conditioned at ambient temperature. DOE

N81-11243# Brookhaven National Lab., Upton, N. Y.
CROP RESIDUES AS A FUEL FOR POWER GENERATION
N. Bhagat, H. Davitian, and R. Pouder 1979 20 p refs
(Contract DE-AC02-76CH-00016)
(BNL-50982) Avail: NTIS HC A02/MF A01

Crop residues could serve as an alternative energy source for producing electric power and heat in agricultural regions of the United States. Nearly 2 quads of residues are estimated to be available as a sustainable annual yield. These can substitute for up to one quad of conventional fuels used to generate electricity and up to an additional quad of petroleum and natural gas currently used for producing heat. The most promising routes to residue conversion appear to be regional generators sized in the megawatt range, and the mixing of residues with coal for burning in coal power plants. Costing farmers from $0.70 to $1.25 per million Btu, to harvest and prepare for use as a fuel, residues can be a competitive renewable energy supply. DOE

N81-11244# RAND Corp., Santa Monica, Calif.
VALUES IN CONFLICT: DESIGN CONSIDERATIONS FOR A TWO-STAGE SYNFUELS DEVELOPMENT STRATEGY
David Seidman Apr. 1980 38 p refs
(Contract DE-AC01-79PE-70078)
(RAND/N-1469-DOE) Avail: NTIS HC A03/MF A01

Some features of the design of a two stage synfuels development program serving to reduce potential conflict between the values served by synfuels development and other important public values are considered. The potential conflict between synfuels development and values protected or implemented by existing laws and regulations is discussed. The design of the first stage of development might substantially reduce conflict among these values and conflict between synfuels promoters and defenders of other values. It also suggests how first stage design might help generate information to inform decisions concerning the scope and scale of the second state and facilitate further protection of values in the event of second stage development. Approaches to avoiding unnecessary damage to competing values in second stage planning are discussed. Approaches to site selection that allow accommodation of national interests and the legitimate interests of the states are considered. DOE

N81-11245# Los Alamos Scientific Lab., N. Mex.
METHANE HYDRATE AS AN ENERGY RESEARCH. A REVIEW WITH RECOMMENDED FUTURE RESEARCH
B. L. Barraclough Jun. 1980 33 p refs
(Contract W-7405-eng-36)
(LA-8368-MS) Avail: NTIS HC A03/MF A01

A review of current knowledge concerning the nature, evidence

for natural occurrence, and resource potential of methane (natural gas) hydrate is presented. Soviet production technology is briefly surveyed, and an outline of research necessary for understanding, assessing, and exploiting unconventional energy resource is included. DOE

N81-11246# Brookhaven National Lab., Upton, N. Y.
FLASH HYDROPYROLSIS OF COAL Quarterly Report, 1 Jul. - 30 Sep. 1979
Meyer Steinberg, Peter Fallon, and Bharat L. Bhatt Dec. 1979 99 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51172; QR-10) Avail: NTIS HC A05/MF A01

A parametric study of New Mexico sub-bituminous coal is discussed. This coal has been found to be considerably more reactive than the lignite previously studied, particularly at 500 psi where the gaseous yields were approximately twice that of the lignite (35% vs 17%) and liquids two to four times greater (10% vs 2.6 to 4.6%). The relationship between the yield of gaseous hydrocarbons from sub-bituminous coal at 900 C and the hydrogen partial pressure is not as linear as originally thought. At pressures below 1000 psi, there is an absolute increase of 3.75% per 100 psi increase in hydrogen partial pressure while above 1000 0 psi, the value is reduced to 2.2% per 100 psi. Neither the reduction in particle size to less than 50 microns nor the addition of Na2CO3 showed any significant change in yield obtained with the sub-bituminous coal at 900 C and 1000 psi. Data from experiments using North Dakota lignite are analyzed. DOE

N81-11247# Bituminous Coal Research, Inc., Monroeville, Pa.
TEST AND EVALUATE THE TRI-GAS LOW-BTU COAL GASIFICATION PROCESS Quarterly Report, Apr. - Jun. 1980
Jul. 1980 14 p
(Contract DE-AC01-78ET-10254)
(DOE/ET-10254/82; BRC-L-1115) Avail: NTIS HC A02/MF A01

Four tests were conducted in the TRI-GAS PEDU. Test no. 3S-55 was prematurely shut down because of failure of the steam boiler. Steady state operation was not achieved. Following repairs to the steam boiler, test no. 3S-56 was conducted. This test was also terminated prematurely, due to failure of the power controller for the steam boiler. Repairs were again made. In test no. 3S-57, bed temperatures in stages 2 and 3 were lower than required for gasification, although some reaction occurred at the top of the reactors where the temperatures exceeded 1600 F. The test was conducted somewhat prematurely due to plugging of the coal feed line. Test no. 3S-58, an integrated three stage test, was conducted in June. The heating value of the product gas was about 100 Btu per cu ft even though failure of the reactor heaters prevented the stage 2 temperature from exceeding 1550 F. DOE

N81-11248# Rockwell International Corp., Canoga Park, Calif. Environmental and Energy System Div.
ADVANCED DEVELOPMENT OF A SHORT-RESIDENCE-TIME HYDROGASIFIER Quarterly Technical Progress Report, 1 Apr. - 30 Jun. 1980
J. Friedman Jul. 1980 161 p refs
(Contract DE-AC01-78ET-10328)
(FE-3125-21) Avail: NTIS HC A08/MF A01

Efforts in the development of the Rockwell single-stage short-residence-time hydrogasifier for the gasification of coal and peat are reported. These involve test results, the design and construction of a 3/4-TPH coal feed rate integrated process development unit, materials and engineering studies for a commercial plant, process optimization, hydrogen production studies, utilization of chars, economic analysis and analytical evaluation of experiments with peat. DOE

N81-11249# Dynatech R/D Co., Cambridge, Mass.
FEASIBILITY STUDY FOR ANAEROBIC DIGESTION OF AGRICULTURAL CROP RESIDUES
Edward Ashare, Michael C. Buivid, and Elizabeth H. Wilson 31 Jul. 1979 251 p refs
(Contract DE-AC02-77CH-00178)
(SERI/TR-8157-1T1; Dynatech-Rept-1935) Avail: NTIS HC A12/MF A01

Cost estimates for the pretreatment/digestion of crop residues to fuel gas are provided. A review of agricultural statistics indicated that the crop residues wheat straw, corn stover, and rice straw are available in sufficient quantity to provide meaningful supplies of gas. Engineering economic analyses were performed for digestion of wheat straw, corn stover, and rice straw for small farm-, cooperative-, and industrial scales. The small farm scale processed the residue from an average size US farm (400 acres), and the other sizes were two and three orders of magnitude greater. The results of the analyses indicate that the production of fuel gas from these residues is, at best, economically marginal, unless a credit can be obtained for digester effluent. The use of pretreatment can double the fuel gas output but will not be economically justifiable unless low chemical requirements or low cost chemicals can be utilized. Use of low cost hole in the ground batch digestion results in improved economics for the small farm size digestion system. DOE

N81-11250# Argonne National Lab., Ill. Materials Science Div.
MATERIALS TECHNOLOGY FOR COAL-CONVERSION PROCESSES Progress Report, Jan. - Mar. 1980
Jun. 1980 54 p refs
(Contract W-31-109-eng-38)
(ANL-80-46) Avail: NTIS HC A04/MF A01

Nondestructive testing, failure analysis, and studies of erosive wear, corrosion, and refractory degradation are discussed. Analysis of recent refractory slay interaction tests suggests that as the chromia content is increased from 10 to 32 percent the primary reaction product changes from calcium hexaluminate to spinel, significantly increasing the corrosion resistance of the refractory. Field reliability of the high temperature ultrasonic erosion scanner was demonstrated at both a coal liquefaction plant and a coal gasification plant. Continuous high temperature operation was demonstrated and an accuracy of ± 0.025 mm seems achievable. Results of tests utilizing 10,000-h exposures suggest that corrosion rates of 0.6 mm/y can be expected. Failure analysis activities included studies of compressor diaphragms. Cracks were found in two of the three diaphragms. DOE

N81-11251# Battelle Columbus Labs., Ohio.
FUELS FROM BIOMASS SYSTEMS FOR ARID LAND ENVIRONMENTS
Edward S. Lipinsky, Steven Kresovich, J. R. Goodin, ed., and David K. Northington, ed. 1979 13 p refs
(Contract W-7405-eng-92)
(DOE/TIC-11247) Avail: NTIS HC A02/MF A01

Integrated fuels from biomass systems that might function in arid environments are discussed and illustrated. The emphasis is on principles and strategic guidelines for use by those initiating studies on arid land fuels from biomass. DOE

N81-11252# California Univ., Livermore. Lawrence Livermore Lab.
MINIMALLY REFINED BIOMASS FUELS: AN ECONOMIC SHORTCUT
R. K. Pearson and T. B. Hirschfeld Jul. 1980 9 p refs Presented at the 4th Intern. Symp. on Alcohol Fuels Technol., Sao Paulo, Brazil, 5-8 Oct. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84136; CONF-801030-1) Avail: NTIS HC A02/MF A01

An economic shortcut can be realized if the sugars from which ethanol is made are utilized directly as concentrated aqueous solutions for fuels rather than by further refining them through fermentation and distillation steps. Simple evaporation of carbohydrate solutions from sugar cane or sweet sorghum, or from hydrolysis of starch or cellulose content of many plants yield potential liquid fuels of energy contents (on a volume basis) comparable to highly refined liquid fuels like methanol and ethanol. The potential utilization of such minimally refined biomass derived fuels is discussed and the burning of sucrose-ethanol-water solutions in a small modified domestic burner is demonstrated. Other potential uses of sugar solutions or emulsion and microemulsions in fuel oils for use in diesel or turbine engines are proposed and discussed. DOE

N81-11253# Bituminous Coal Research, Inc., Monroeville, Pa.
SURVEY OF COAL INDUSTRY PROGRAMS FOR UTILIZATION OF METHANE FROM COAL SEAMS Final Report, 31 Mar. - 31 Oct. 1979
David C. Uhrin, F. DuBreuil, and R. D. Saltsman 14 Feb. 1980 39 p refs
(Contract GRI-5010-380-0164)
(PB80-205305; GRI-79/0044; BCR-L-1068) Avail: NTIS HC A03/MF A01 CSCL 21D

The activity in the private sector of the United States regarding removal and utilization of coalbed methane was determined. An attempt was made to learn to what extent and for what purposes coalbed methane is currently being used, what experimental programs exist, and what programs are planned or proposed. Information was obtained primarily from interviews with coal industry personnel familiar with the subject of recovery of methane from coalbeds. GRA

N81-11254# Office of Technology Assessment, Washington, D. C.
ENERGY FROM BIOLOGICAL PROCESSES
Jul. 1980 204 p refs
(PB80-211477; OTA-E-123) Avail: NTIS HC A10/MF A01 CSCL 21D

Analysis of prominent biomass issues is presented, as well as summaries of four biomass fuel cycles, a description of biomass' place in two plausible energy futures, and discussions of policy options for promoting energy from biomass. The four fuel cycles (wood, alcohol fuels, grasses and crop residues, and animal wastes) were chosen because of their near to midterm energy potential. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N81-11255# Middlesex Research Center, Inc., Washington, D.C.
UNITED STATES METRIC BOARD. A STUDY OF METRIC MEASUREMENT AND LEGISLATION, VOLUME 1 Final Report
10 Sep. 1979 166 p Sponsored by US Metric Board 2 Vol.
Avail: NTIS HC A08/MF A01

The status of metrication in the nation was examined as a step toward proving an effective structural mechanism for converting customary units to metric units in statutes, regulations, and other laws at all levels of government, on a coordinated timely basis, in accordance with Section 6(11) of the U.S. Metric Conversion Act of 1975 (PL 94-168). Current voluntary, legislative, and regulative environments in the U.S. are examined. The need for an effective change mechanism and alternative change mechanisms are examined. The overall recommended strategy for change is presented and implementation tasks are delineated. The Legal Advisory Panel and data collection methodology are described. Relevant experiences of Canada and Australia are summarized. A.R.H.

N81-11256# Middlesex Research Center, Inc., Washington, D.C.
UNITED STATES METRIC BOARD. A STUDY OF METRIC MEASUREMENT AND LEGISLATION, VOLUME 2 Final Report
10 Sep. 1979 203 p 2 Vol.
Avail: NTIS HC A10/MF A01

The official text of a proposed uniform metric system procedures act is presented which is designed to regulate conversion to the metric system of measurement. Proposed Florida State metric legislation is included as well as North Dakota statutes (46-03-10) arranging and correcting laws and computer searches of metric legislation conducted by Oklahoma and Colorado. A.R.H.

N81-11257# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
MAINTENANCE AND PRESERVATION OF CONCRETE STRUCTURES. REPORT 3: ABRASION-EROSION RESISTANCE OF CONCRETE
Tony C. Liu Jul. 1980 134 p refs
(AD-A090032; WES-TR-C-78-4-3; Rept-3) Avail: NTIS HC A07/MF A01 CSCL 11/2

This report describes a laboratory test program on abrasion-erosion resistance of concrete, including the development of a new underwater abrasion-erosion test method. This program was designed to evaluate the relative abrasion-erosion resistance of various materials considered for use in the repair of erosion-damaged concrete structures. The test program encompassed three concrete types (conventional concrete, fiber-reinforced concrete, and polymer concrete); seven aggregate types (limestone, chert, trap rock, quartzite, granite, siliceous gravel, and slag); three principal water-cement rations (0.72, 0.54, and 0.40); and six types of surface treatment (vacuum, polyurethane coating, acrylic mortar coating, epoxy mortar coating, furan resin mortar coating, and iron aggregate topping). A total of 114 specimens made from 41 batches of concrete was tested. Based on the test data obtained, a comprehensive evaluation of the effects of various parameters on the abrasion-erosion resistance of concrete was presented. Materials suitable for use in the repair of erosion-damaged concrete structures were recommended. Additional work to correlate the reported findings with field performance was formulated. GRA

N81-11258# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
MAINTENANCE AND PRESERVATION OF CONCRETE STRUCTURES. REPORT 2: REPAIR OF EROSION-DAMAGED STRUCTURES
James E. McDonald Apr. 1980 311 p refs
(AD-A089764; WES-TR-C-78-4-2; Rept-2) Avail: NTIS HC A14/MF A01 CSCL 13/13

The primary objectives of the initial phase of this investigation were to (a) identify and evaluate various abrasion-erosion-resistant materials for repairing and improving the durability of concrete stilling basin slabs, (b) develop optimum techniques for repair and rehabilitation of stilling basins, and (c) develop guidance for designing stilling basin exit configurations to avoid entrapping abrasive materials within the basin. A survey of Corps Divisions and District offices identified 52 structures that have experienced concrete damage due to erosion. Depths of erosion ranged from a few inches to approximately 10 ft. In general, this erosion damage resulted from the abrasive effects of waterborne rocks and other debris being circulated over the concrete surface during construction and operation of the structure. A variety of materials including armored concrete, conventional concrete, epoxy resins, fiber-reinforced concrete, and polymer-impregnated concrete were used with varying degrees of success in the 31 repairs reported. The degree of success generally was inversely proportional to the degree of exposure to those conditions conducive to erosion damage. These materials have been used with various construction procedures, including dewatering and underwater repairs. GRA

N81-11259# Army Command and General Staff Coll., Fort Leavenworth, Kansas.
CURRENT TRENDS IN METRIC CONVERSION IN THE UNITED STATES POTENTIAL TROUBLE FOR NATIONAL DEFENSE
Keith W. Jones, Jr. May 1980 45 p refs
(AD-A090046; AD-E750015) Avail: NTIS HC A03/MF A01 CSCL 12/1

Conversion to the metric system of weights and measures in the United States appears inevitable, but is being prolonged due to present legislation which allows each industrial sector to convert voluntarily at its own desired pace. This study analyzes the impact of a prolonged dual-measurement system on military readiness and capabilities, and concludes that debilitating national defense problems will occur if the country does not soon embark on a course of authoritative centralized planning and leadership toward metrication in the shortest possible time. The study recommends that the Defense Department actively call on Congress to pursue such a course. GRA

N81-11260# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
HOLE BURNING FILTER CRYOGENIC COOLING FEASIBILITY STUDY Final Report

R. D. Rochat and J. E. Jackson 15 Dec. 1979 29 p refs
(Contract N00014-79-C-0641)
(AD-A089942) Avail: NTIS HC A03/MF A01 CSCL 13/1

The Hole Burning Filter Receiver is an attractive filter concept for utilization in a strategic laser communications system for submerged submarines. The feasibility of this approach depends upon the ability to maintain the filter at cryogenic (approximately 4 degrees K) temperatures. This final report submits an evaluation of a cryogenic cooling system for the hole burning filter including estimates of size, weight, and power. GRA

N81-11261# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Experimental Engineering Div.

TIME CONSTRAINTS ON MEASURING BUILDING R-VALUES

Stephen N. Flanders Jun. 1980 33 p refs
(DA Proj. 4A7-62730-AT-42)
(AD-A089712; CRREL-80-15) Avail: NTIS HC A03/MF A01 CSCL 13/3

This report discusses the time constraints on measuring the thermal resistance (R-value) of building components. Temperature changes on either side of a building component perturb measurement accuracy. Long measurement times and measurement times corresponding to a consistent diurnal cycle can be satisfactory; however, individual temperature changes cause significant error for shorter measurement periods. This report shows how to scale the thermal properties of individual constituent materials in a building element to determine its characteristic thermal time constant. The report then demonstrates the size of measurement error resulting from a variety of changes in temperature with representative walls of different time constants. GRA

N81-11262# Department of Energy, Washington, D. C.

METHOD FOR ENGINEERING CALCULATION AND SELECTION OF PARAMETERS FOR THE POWER SYSTEMS OF BATTERY-POWERED ELECTRIC AUTOMOBILES

E. M. Dilanyan and A. A. Momdzhyan 1979 8 p Transl. into ENGLISH from 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 8 p Conf. held at Erevan, USSR, 1979
(DOE-TR-239) Avail: NTIS HC A02/MF A01

A method for engineering calculation and selection of parameters for the power systems of battery powered electric automobiles (EA) was examined. The EA range in capacity from 0.5 to 1.2 tons is dependent on the requirements imposed by the production assignment for the specifications of the EA being designed and operating conditions. DOE

N81-11263# Bendix Corp., Kansas City, Mo.

PRELIMINARY STUDY OF HIGH-SPEED MACHINING

R. E. Jordan Jul. 1980 99 p refs
(Contract DE-AC04-76DP-00613)
(BDX-613-2401) Avail: NTIS HC A05/MF A01

The feasibility of a high speed machining process was established for application to Bendix aluminum products, based upon information gained through visits to existing high speed machining facilities and by the completion of a representative Bendix part using this process. The need for an experimental high speed machining capability at Bendix for further process evaluation is established. DOE

N81-11264# Bendix Corp., Kansas City, Mo.

DEBURRING: TECHNICAL CAPABILITIES AND COST-EFFECTIVE APPROACHES, LESSONS 3 AND 4

L. K. Gillespie Jun. 1980 75 p refs
(Contract DE-AC04-76DP-00613)
(BDX-613-2373) Avail: NTIS HC A04/MF A01

This ten lesson text on deburring is designed to provide engineers and production supervisors with an overall understanding of deburring economics and current capabilities. The material included describes economics, side effects, process selection techniques, product design influences, standards, plantwide approaches, burr formation, and prevention. Deburring methods described include barrel, centrifugal barrel, vibratory, spindle, manual, electrochemical, electropolish, brush, abrasive jet, abrasive flow, water jet, thermal energy, and mechanized mechanical. Lessons 3 and 4 describe product design influences and burr prevention and minimization respectively. DOE

N81-11265# Institute of Gas Technology, Chicago, Ill.

DEVELOPMENT AND FIELD VERIFICATION OF A MODEL OF EXCESS INFILTRATION AND HOUSE AIR INFILTRATION FOR SINGLE-FAMILY RESIDENCES Final Report, 1979

James T. Cole, Jon W. Zimmer, Thomas S. Zawacki, John A. Kinast, and Robert H. Elkins Jan. 1980 53 p refs Sponsored by Gas Research Inst.
(PB80-205396; GRI-79/0031) Avail: NTIS HC A04/MF A01 CSCL 13A

A comprehensive series of studies was conducted to quantify the factors affecting seasonal efficiency of space heating furnaces. Initial data were developed (in a laboratory model of a house) on how furnace cycling, wind speed, and structure looseness (or air charge rate) affect chimney flow by simulating a specific installation. A field study was also conducted in 20 test homes to verify the model, to extend its applicability to a wider spectrum of installations and residences, and to obtain additional practical data from the structures (e.g., crack lengths) in order to simplify the model for use by utilities, contractors, and furnace manufacturers. The results extended the applicability of the model to installations equipped with furnace retrofits (e.g., derates and vent restrictors). The results also indicated that the excess house infiltration, due to the existence and operation of a furnace, is variable and depends on the structure, installation, and climate. R.C.T.

N81-11266# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

FAULT TOLERANCE DESIGN AND REDUNDANCY MANAGEMENT TECHNIQUES

Sep. 1980 175 p refs Lecture Series held in Athens, 13-14 Oct. 1980; Rome, 16-17 Oct. 1980; and London, 20-21 Oct. 1980
(AGARD-LS-109; ISBN-92-835-0274-4) Avail: NTIS HC A08/MF A01

Basic theory on concepts involved in the application of advanced software, state estimation, and implementation techniques involved in redundancy management are provided. A review covering the necessary background and state of the art involved in the application of such technologies is given. For individual titles, see N81-11267 through N81-11275.

N81-11267# Honeywell Systems and Research Center, Minneapolis, Minn.

FAULT TOLERANCE DESIGN AND REDUNDANCY MANAGEMENT TECHNIQUES: INTRODUCTION AND OVERVIEW

Thomas B. Cunningham *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 2 p (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

A brief discussion is given of the motivation for fault tolerance through failure management. The technical scope of the lecture series is also bounded. E.D.K.

N81-11268# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.

FAILURE DETECTION IN DYNAMIC SYSTEMS **c38**

Alan S. Willsky *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 14 p refs (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

An introduction to the basic concepts behind the design of algorithms for the detection of failures in dynamic systems is presented. Attention is focused on two important methods: the multiple model (MM) technique and the generalized likelihood ratio (GLR) method. In the context of these two methods many of the fundamental issues that arise in failure detection are explored, including the structure of failure detection algorithms, the computational complexity of different approaches, and the different modeling and system configuration assumptions on which different algorithms are based. Following these discussions attention is focused on two issues: the robust use of analytical redundancy in practical applications and the design of decision rules that reflect the system tradeoffs that must be made. E.D.K.

N81-11269# Saab-Scania, Linkoping (Sweden). Aerospace Div.

COMPUTER BASED IN-FLIGHT MONITORING **c08**

Kjell Folkesson *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 23 p (For primary document see N81-11266 02-31)

Avail: NTIS HC A08/MF A01

Various computer techniques used to monitor flight safety critical flight control systems components such as sensors, servos, and the FSC computer itself are described. Flight safety critical FCS sensors and usually redundant. The degree of redundancy is a function of the control authority of the sensors, the stability of the aircraft, and existing back-up arrangements. The digital FCS computer can be used for servo monitoring in many different ways. The servo configuration usually determines the best monitor solution. In redundant servo configurations, various signals, such as electrical current, differential pressure, velocity, or servo position, can be provided to the digital comptuer and monitored for failure detection. The FCS digital computer is usually a flight safety critical element and must be closely monitored. Failures must be detected and isolated with very high confidence. In redundant digital FCS computers, both computer self test and monitoring of the computer outputs are used to detect computer failures. The monitoring can be relized in software or in external hardware. E.D.K.

N81-11270# Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France).

DETECTING THE FAILURE OF AIRCRAFT SENSORS USING ANALYTICAL REDUNDANCY [DETECTION DE PANNE DE CAPTEURS D'AVION PAR UTILISATION DE LA REDONDANCE ANALYTIQUE] **c38**

Marc Labarrere *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 17 p refs In FRENCH; ENGLISH summary (For primary document see N81-11266 02-31)

Avail: NTIS HC A08/MF A01

Failure detection techniques implemented on-board aircraft must be simple and robust. By replacing a triplex vital system with a duplex system associated with analytical redundancy, the problem is reduced to isolating the failed sensor. Estimation techniques are well suited here because of the atmospheric turbulence factor. Different techniques have been used according to whether the nature of the analytical redundancy is stochastic, deterministic, static, or dynamic. Various estimation algorithms used include: (1) mixed observations; (2) estimation by observers or Kalman filters, using one or several quations and one or several measurements; and (3) autoadaptive techniques by identifying the flight configuration. A solution based on the choice and use of deterministic redundancy relations which are independent of atmospheric disturbances is presented and applied to the records of real flights. Transl. by A.R.H.

N81-11271*# SRI International Corp., Menlo Park, Calif. Computer Science Lab.

SOFTWARE VALIDATION AND VERIFICATION TECHNIQUES **c38**

Karl N. Levitt *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 9 p refs (For primary document see N81-11266 02-31)

(Contract NAS1-15528)

Avail: NTIS HC A08/MF A01 CSCL 09B

Computers are being increasingly used as a critical component in nuclear reactors, aircraft, and other applications, where a failure can be life-threatening. Recent studies revealed that a centralized computer controlling a commercial aircraft should have a mean time to failure of at least 10,000 years. By the judicious application of hardware redundancy, such a reliability can be approached assuming perfect software. The emerging technique of program verification gives promise of leading to vastly more reliable programs. Program verification is, at least conceptually, a very simple idea: by mathematical reasoning a program, for all input values, is shown to yield output values defined by an independently supplied formal specification. The state of the art in program verification is summarized addressing the following issues: available techniques and on-line tools: the cost of verifying a system; possible sources of unreliability in an alleged proof; and outstanding technical problems. A brief description is given of the SIFT (Software Implemented Fault Tolerance) computer, and efforts to prove the correctness of its operating system E.D.K.

N81-11272# Honeywell Systems and Research Center, Minneapolis, Minn.

FAILURE MANAGEMENT TECHNIQUES FOR HIGH SURVIVABILITY **c38**

Thomas B. Cunningham *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 25 p refs (For primary document see N81-11266 02-31)

Avail: NTIS HC A08/MF A01

Survivability of aircraft can be greatly enhanced by employing a number of considerations and techniques in design and placement of avionics components. The initial sizing and location of surfaces should include the impact of survivability. Avionics hardware sharing offers cost reductions and can provide high performance if reliability and survivability issues are successfully addressed. Observers offer a structure for seeking solutions to surivability problems. Observers for in the loop sensor reconstruction often require stability margin enhancement. Techniques for examining this problem and improving stability exist. These considerations are discussed in detail and are combined with trends in sensor and computer technology to formulate a candidate for a flutter mode control implementation. E.D.K.

N81-11273# Saab-Scania, Linkoping (Sweden). Aerospace Div.

FAILURE MANAGEMENT FOR THE SAAB VIGGEN JA37 AIRCRAFT **c38**

Kjell Folkesson *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 21 p ref (For primary document see N81-11266 02-31)

Avail: NTIS HC A08/MF A01

The JA-37 Viggen is the first military aircraft in series production and field-service equipped with a digital automatic flight control system. The JA-37 Digital Automatic Flight Control System has high control authority and is a flight safety critical system. It has duplex sensors, a single channel digital computer, and simple secondary servos. The digital computer performs control-law calculation and sensor and servo monitoring, as well as extensive self test on ground and during flight. The sensors are monitored by comparison. The servos are monitored by comparing the output from a software model with the servo output. E.D.K.

N81-11274*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.

FLIGHT EXPERIENCE WITH FLIGHT CONTROL REDUNDANCY MANAGEMENT **c08**

Kenneth J. Szalai, Richard R. Larson, and Richard D. Glover *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 27 p refs (For primary document see N81-11266 02-31)

Avail: NTIS HC A08/MF A01 CSCL 01C

Flight experience with both current and advanced redundancy management schemes was gained in recent flight research programs using the F-8 digital fly by wire aircraft. The flight performance of fault detection, isolation, and reconfiguration (FDIR) methods for sensors, computers, and actuators is reviewed. Results of induced failures as well as of actual random failures are discussed. Deficiencies in modeling and implementation techniques are also discussed. The paper also presents comparison off multisensor tracking in smooth air, in turbulence, during large maneuvers, and during maneuvers typical of those of large commercial transport aircraft. The results of flight tests of an advanced analytic redundancy management algorithm are compared with the performance of a contemporary algorithm in terms of time to detection, false alarms, and missed alarms. The performance of computer redundancy management in both iron bird and flight tests is also presented. E.D.K.

N81-11275# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. for Flight System Dynamics.

ROBUST CONTROL SYSTEM DESIGN **c08**

J. Ackermann *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 14 p refs (For primary document

see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

The short period longitudinal mode of an F 4-E with horizontal canards is instable in subsonic flight and unsufficiently damped at supersonic speed. The control system has to provide acceptable pole locations according to military specifications for flying qualities. A fixed gain controller using three paralleled gyros is designed, such that the pole region requirements in four typical flight conditions are robust with respect to gain reduction to one third. Thus nothing bad happens immediately after one or two gyro failures. Failure detection and redundancy management may be performed at a higher hierarchical level, which does not have to be extremely fast. The use of accelerometers or air data sensors for angle of attack or dynamic pressure is totally avoided in this concept and no gain scheduling is necessary. The design for robustness with respect to different flight conditions and sensor failures is performed by a novel parameter space design tool. E.D.K.

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N81-11276 Columbia Univ., New York.
LIGHT STATISTICS, PHOTON STATISTICS AND THE PROBLEM OF DEAD TIME PHOTODETECTION Ph.D. Thesis
Giovanni Vannucci 1980 83 p
Avail: Univ. Microfilms Order No. 8023558

The detection of very small amounts of visible electromagnetic radiation is often accomplished by counting single quanta. Under these conditions special problems arise, due to the inherent randomness of the quanta. A few problems of this type are addressed and solutions for some of them are presented. The problem of detector dead time is examined in conjunction with radiation whose intensity is not constant in time, such as the radiation from most natural and manmade sources. Expressions are presented for the dead time modified mean and variance of the photocounting distribution, together with experimental results that are in very good agreement with the theory. A series of optical experiments is reported that verifies theoretical photocounting distributions obtained earlier for detectors with and without nonparalyzable deaf time, with modulated laser radiation. An expression is obtained for the photocounting distribution in the presence of modulated and paralyzable dead time. Dissert. Abstr.

N81-11277*# Hughes Aircraft Co., El Segundo, Calif. Radar Systems Group.
KU-BAND RENDEZVOUS RADAR PERFORMANCE COMPUTER SIMULATION MODEL Final Report
J. W. Griffin Jul. 1980 326 p refs
(Contract NAS9-15840)
(NASA-CR-160883) Avail: NTIS HC A15/MF A01 CSCL 17I

The preparation of a real time computer simulation model of the KU band rendezvous radar to be integrated into the shuttle mission simulator (SMS), the shuttle engineering simulator (SES), and the shuttle avionics integration laboratory (SAIL) simulator is described. To meet crew training requirements a radar tracking performance model, and a target modeling method were developed. The parent simulation/radar simulation interface requirements, and the method selected to model target scattering properties, including an application of this method to the SPAS spacecraft are described. The radar search and acquisition mode performance model and the radar track mode signal processor model are examined and analyzed. The angle, angle rate, range, and range rate tracking loops are also discussed. A.R.H.

N81-11278*# University of Central Florida, Orlando.
OPTICAL FIBER DISPERSION CHARACTERIZATION STUDY Final Report, Dec. 1978 - Dec. 1979
Alan Geeslin, Achia ArRiad, Sedki M. Riad, and Michael E. Padgett Dec. 1979 162 p refs
(Contract NAS10-9455)
(NASA-CR-165624; KSC-TR-32-3) Avail: NTIS HC A08/MF A01 CSCL 20F

The theory, design, and results of optical fiber pulse dispersion measurements are considered. Both the hardware and software required to perform this type of measurement are described. Hardware includes a thermoelectrically cooled injection laser diode source, an 800 GHz gain bandwidth produce avalanche photodiode and an input mode scrambler. Software for a HP 9825 computer includes fast Fourier transform, inverse Fourier transform, and optimal compensation deconvolution. Test set construction details are also included. Test results include data collected on a 1 Km fiber, a 4 Km fiber, a fused spliced, eight 600 meter length fibers concatenated to form 4.8 Km, and up to nine optical connectors. A.R.H.

N81-11279 British Broadcasting Corp., Kingswood (England). Engineering Div.
INTERFERENCE CAUSED BY TELEVISION RECEIVERS TO RECEPTION AT 200 kHz
D. J. Whythe Sep. 1980 11 p
(BBC-RD-1980/10) Avail: NTIS HC A02/MF A01

A survey of the degree and widespread nature of the interference caused by television receivers to Radio 4 reception on 200 kH is described. Seventy five fully completed questionnaires were received from locations spread widely over the UK. The survey showed that 58 of those 75 questionnaires reported an impairment to 200 kHz reception which, on average, exceeded one grade on the CCIR 5 point impairment scale, when the 200 kHz receiver was within 3 m from the television receiver but that the effect reduced rapidly with distance, the average impairment becoming only about one half grade when the receivers were 5 m apart. On the other hand, partition walls of brick or stone built houses provided negligible protection. Monochrome and color television receivers caused similar degrees of interference. No individual make or model appeared to be either particularly good or particularly bad. R.K.G.

N81-11280# Hazeltine Corp., Greenlawn, N. Y.
METAL-GRID SPATIAL FILTER, VOLUME 1 Interim Report, Sep. 1978 - Aug. 1979
P. W. Hannan and P. L. Burgmyer Jul. 1980 124 p refs
(Contract F19628-78-C-0152; AF Proj. 4600)
(AD-A089792; RADC-TR-79-295-Vol-1; Rept-6372-Vol-1)
Avail: NTIS HC A06/MF A01 CSCL 09/1

This interim report presents the results of studies relevant to the design of spatial filters that have metal grids as their basic reflecting element. An analysis of metal-grid spatial filter designs shows the performance that is available. An experimental investigation of various types of metal grids confirms their suitability for spatial filters. GRA

N81-11281# Hazeltine Corp., Greenlawn, N. Y.
METAL-GRID SPATIAL FILTER, VOLUME 2 Interim Report, Sep. 1978 - Aug. 1979
P. W. Hannan and P. L. Burgmyer Jul. 1980 115 p
(Contract F19628-78-C-0152; AF Proj. 4600)
(AD-A089756; RADC-TR-79-295-Vol-2; Rept-6372-Vol-2)
Avail: NTIS HC A06/MF A01 CSCL 09/1

Data from the analysis of several metal-grid spatial filter designs are presented. Graphs illustrating transmission and passband reflection and transmission in the G and H planes are given along with filter characterizations. M.G.

N81-11282# Delaware Univ., Newark. Applied Mathematics Inst.
THE INVERSE ELECTROMAGNETIC SCATTERING PROBLEM FOR A PERFECTLY CONDUCTING CYLINDER Interim Report
David Colton 15 May 1980 20 p refs
(Grants AF-AFOSR-2879-76; NSF MCS-78-02542; AF Proj. 2304)
(AD-A089874; TR-69A; AFOSR-80-0638TR) Avail: NTIS HC A02/MF A01 CSCL 20/14

We consider the problem of determining the shape of the

cross section of a simply connected perfectly conducting infinite cylinder from a knowledge of the far field pattern for all angles of observation and small values of the wave number. The method we propose relies heavily on conformal mapping techniques. The transfinite diameter is determined by changing the polarization of the incoming wave and measuring the far field pattern of the resulting magnetic field. Of particular interest is the case when only a finite number of the Fourier coefficients of the far field pattern are known, and in this situation we obtain error estimates by using results on coefficients estimates for univalent functions. GRA

N81-11283# *Delaware Univ., Newark. Applied Mathematics Inst.*

SCATTERING CONTROL BY IMPEDANCE LOADING Interim Report

T. S. Angell and R. E. Kleinman 1980 8 p refs
(Grant AF-AFOSR-0085-79; AF Proj. 2304)
(AD-A090177; TR-81A; AFOSR-80-0963TR) Avail: NTIS HC A02/MF A01 CSCL 20/14

The time harmonic electromagnetic scattering problem with impedance boundary conditions on a cylinder of smooth but otherwise arbitrary cross section is reduced to a pair of boundary integral equations. These integral equations are shown to have a unique square integrable solution for bounded impedances, for all real values of wave number with no exceptional values corresponding to interior resonances. This result is then employed to prove that there exists an impedance function which optimizes the amount of power scattered in an angular sector of the far field. The power in the angular sector is considered as the cost functional over a control set of admissable impedances consisting of a closed bounded convex set in the space dual to the space of functions integrable over the boundary. Methods for the numerical approximation of the optimal impedance are discussed. GRA

N81-11284# JAYCOR, Del Mar, Calif.

USE OF ELECTRO-OPTIC TECHNIQUES TO ACHIEVE ELECTROMAGNETIC PULSE HARDNESS DETERMINATIONS OF THE EFFECTIVENESS OF OPTICAL FIBER AND HARDWIRED INTERFACE TECHNOLOGIES IN MILITARY COMMUNICATION SYSTEMS IN A NUCLEAR ENVIRONMENT Final Report, Sep. 1979 - Apr. 1980

R. A. Greenwell, W. A. Radasky, W. H. Hardwick, and T. M. Flanagan 12 Jun. 1980 64 p refs
(Contract N66001-79-C-0191)
(AD-A089850; NOSC-TR-564) Avail: NTIS HC A04/MF A01 CSCL 17/2

Fiber optics will reduce the susceptibility of systems to a direct EMP threat. Cables shorter than 10m present a tradeoff between the shielding effectiveness of standard cables and that of shielding around critical fiber optic receiver components. Long-haul ground systems require only electronics protection; the fiber optic cable is immune to em pickup and need not be buried for protection. Fiber optic susceptibility is less than that of hardwire to burnout and upset in systems that allow an outage time of 1 ms. In a steady-state or low-dose-rate environment, system vulnerability levels depend on fiber response and design margin. A fiber optic interface is feasible which will not fail under the dose rates and total dose levels equivalent to a natural space environment of 0.002 rad(Si) per second for 7 years. Fiber optic system electronics are no more vulnerable to total dose than those of hard-wired systems, which, at practical dose levels of 1 Mrad, do not appear vulnerable. In fiber optic cables, vulnerability level depends on cable type and system design margin. Insufficient data exist to estimate vulnerability levels for the fiber optic systems in displacement damage-producing environments. The report contains a list of 70 references. GRA

N81-11285# Army Armament Research and Development Command, Dover, N. J. Fire Control and Small Caliber Weapon Systems Lab.

RADAR CLUTTER MODELS AT 95 GHz

R. D. Hayes Sep. 1980 18 p refs
(DA Proj. 1L1-62617-AH-19)
(AD-A089986; AD-E400477; ARSCD-MR-80001) Avail: NTIS HC A02/MF A01 CSCL 17/9

The purpose of this study was to collect data which have been presented over the past 5 years on radar reflection from material targets and surfaces such as trees, rain and snow for use on the Advanced Fire Control Radar System (AFCORS) Program. Since the data will be used in an air defense application to assist in the prediction of system operation and limitations, only low grazing angles are considered. GRA

N81-11286# *Rensselaer Polytechnic Inst., Troy, N. Y. Microwave Acoustics Lab.*

SIGNAL PROCESSING USING SURFACE ACOUSTIC WAVE DEVICES AND ITS APPLICATION TO SPREAD SPECTRUM COMMUNICATION SYSTEMS Ph.D. Thesis

D. R. Arsenault, L. B. Milstein, and P. Das 13 Dec. 1979 324 p refs
(Grants DAAG29-77-G-0205; NSF ENG-77-23658)
(AD-A089965; RPI-MA-ARO-10; ARO-15004.14-EL) Avail: NTIS HC A14/MF A01 CSCL 17/2

Three Surface Acoustic Wave (SAW) devices, the separated-medium convolver, the memory correlator and the chirp filter are analyzed for signal processing applications. Emphasis is placed on convolution/correlation and Fourier transformation processes. The chirp filter theory is more general and applied equally well to chirp filters fabricated by alternate techniques. In the SAW convolver there is a piezoelectric delay line. Two surface waves are introduced onto the delay line surface by interdigital transducers at its opposing ends. The two waves overlap beneath a semiconductor spaced above the surface and their fields interact with its charge carriers. A non-linear potential is produced and averaged over the semiconductor. From its back contact is obtained the time-compressed convolution of the two signals. The memory correlator is similar to the convolver except that the semiconductor possesses a charge-storage mechanism. Also additional transducers are required for recovery of stored information. GRA

N81-11287# National Communications System, Washington, D. C. Office of Technology and Standards.

REQUIREMENTS FOR FEDERAL EMP PROTECTION STANDARDS FOR TELECOMMUNICATIONS FACILITIES AND EQUIPMENT Final Report

Chadwick Stansberry Jun. 1980 32 p refs
(AD-A089773; AD-E100396; NCS-TIB-80-4) Avail: NTIS HC A03/MF A01 CSCL 17/2

This report identifies three interrelated standardization projects that can lead to the development of Federal EMP protection standards for application to telecommunication facilities and equipment. The purpose and scope of each project is described and provides the necessary focus for understanding the need for additional studies to acquire data for EMP standards. GRA

N81-11288# Pacific-Sierra Research Corp., Santa Monica, Calif.

MEASURING AND INTERPRETING ELF SIGNALS DURING A PCA ASPECTS OF AN EXPERIMENTAL DESIGN Topical Report, 1 Dec. 1978 - 1 Dec. 1979

E. C. Field, Jr. and R. N. DeWitt 1 Dec. 1979 52 p refs
(Contract DNA001-79-C-0015)
(AD-A090121; PSR-932; DNA-5148T) Avail: NTIS HC A04/MF A01 CSCL 20/14

Investigates the design of a transpolar extremely-low-frequency (ELF) experiment that would validate Defense Nuclear Agency propagation codes for ELF system performance in nuclear environments. To be conducted during the next solar maximum, when polar cap absorption events (PCAs) might approximate a nuclear environment, the ideal experiment would simultaneously measure both propagation and ionospheric structure. Propagation measurements would be taken at receivers located such that the direct propagation path did not approach the polar cap boundary; the ELF values would then be compared with computer code outputs. A moderate PCA might cause a 3 to 4 dB reduction in a transpolar ELF signal; a strong event, an 8 or 9 dB reduction. At least 2 hours would be required to resolve amplitude changes in the signal; noise processing to excise large pulses would be essential. Measurements of ionospheric changes would be taken with rocket-borne instruments, entered into computer calculations using the DNA codes, then compared with the propagation measurements. Rocket data should be gathered at 50 km or below; data from previous PCAs obtained only at 60 km or above yield unacceptable uncertainties in calculated field strengths. GRA

N81-11289# Electronics Research Lab., Adelaide (Australia).
A THEORETICAL ANALYSIS OF THE RADAR CROSS SECTION OF THE BICONICAL CORNER REFLECTOR
J. L. Whitrow May 1980 31 p refs
(AD-A089979; ERL-0134-TR; AR-001-982) Avail: NTIS HC A03/MF A01 CSCL 17/9

The biconical corner reflector is a useful device where moderate enhancement of the radar cross section is required. This report uses the principles of physical optics to develop a formula for the radar cross section of an arbitrary biconical corner reflector illuminated at an arbitrary angle of incidence within the confines of the faces of the reflector. Previously published results containing arithmetic and typographical errors for the special case of normal incidence on a symmetrical reflector are corrected. GRA

N81-11290# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
TEST AND EVALUATION OF THE AIRPORT SURVEILLANCE RADAR (ASR)-8 WIND SHEAR DETECTION SYSTEM (PHASE 2), REVISION Interim Report, Apr. - Dec. 1979
D. L. Offi, W. Lewis, T. Lee, and A. DeLaMarche Aug. 1980 40 p refs Revised
(FAA Proj. 022-242-830)
(AD-A090111; FAA-CT-80-17-A-Rev; FAA-RD-80-21-A-Rev) Avail: NTIS HC A03/MF A01 CSCL 17/9

A wind shear detection system developed by the Wave Propagation Laboratory (WPL) to operate with the Federal Aviation Administration (FAA) Airport Surveillance Radar (ASR)-8 was installed and is being tested at the FAA technical Center. Initial efforts, previously reported in Report NA-78-59-LR, were directed toward hardware and software shakedown and feasibility determination. Second phase tests compared radar with aircraft and tower winds, evaluated the wind shear measurement capability under various weather conditions, and investigated the effectiveness of a simple two-azimuth pointing strategy and system capabilities and limitations. Results showed the system to be compatible with and to operate satisfactorily with the ASR-8. The processing and spectral display of clear air and precipitation returns is feasible. The accuracy of agreement between radar-measured winds and components of the aircraft-measured winds in both radially oriented flights and runway offset flights, using a two-azimuth pointing technique, was examined. Radar versus tower wind agreement was also examined. Potentially dangerous wind shears associated with weather during these tests were detectable. Certain system limitations also have been defined and considered. It is recommended that tests continue to complete definition of and demonstrate capabilities in all weather situations, to optimize performance, and to provide information to specify system design for possible development of a prototype model. GRA

N81-11291# Syracuse Univ., N. Y. Dept. of Electrical and Computer Engineering.
AN IMPROVED E-FIELD SOLUTION FOR A CONDUCTING BODY OF REVOLUTION
Joseph R. Mautz and Roger F. Harrington Jun. 1980 78 p refs
(Contract F30602-79-C-0011; AF Proj. 2338)
(AD-A089703; RADC-TR-80-194) Avail: NTIS HC A05/MF A01 CSCL 20/3

The electric field integro-differential equation for electromagnetic scattering from a perfectly conducting body of revolution is solved by the method of moments. A numerical solution is obtained by means of a computer program which is described and listed. This computer program is designed to handle oblique plane wave incidence efficiently. Spatial staggering of expansion functions for the orthogonal components of the induced current is known to give good accuracy when the body of revolution has edges. By means of triangle and pulse expansion functions, this spatial staggering is achieved without the use of shifted source segments. The present computer program is highly competitive with other available programs as concerns storage, execution time, and accuracy. GRA

N81-11292# Stanford Univ., Calif.
ALGORITHM INVESTIGATION FOR LARGE ADAPTIVE ARRAYS Final Technical Report, 15 May - 31 Dec. 1979
B. Widrow, H. Mesiwala, K. Duvall, P. Titchener, R. Gooch, F. McCarthy, and W. Newman Jul. 1980 72 p refs
(Contracts F30602-78-C-0083; N00019-79-C-0331; AF Proj. 2305)
(AD-A089753; RADC-TR-80-234) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report examines the influence of surplus antenna elements in an adaptive array. It is demonstrated that the judicious placement of a few extra antenna elements provides significant performance improvement. In particular, the speed of convergence is improved, and the quality of the antenna beam pattern is enhanced. Convergence rates and beam patterns are closely related to the eigenvalues of the antenna/signal system. A closed form expression is derived for the eigenvalues of a general antenna array with two jammers. From this, expressions for the convergence rate and the optimum beam pattern are found. Computer simulations are used to verify the theoretical developments concerning convergence rates and final beam patterns for a variety of element configurations. GRA

N81-11293# Georgia Inst. of Tech., Atlanta. Electromagnetic Effectiveness Div.
NEAR-FIELD THEORY AND TECHNIQUES FOR WIDEBAND RADIATING SYSTEMS AT IN-BAND AND OUT-OF-BAND FREQUENCIES Interim Technical Report, 1 Feb. 1979 - Mar. 1980
Barry J. Cown and Charles E. Ryan, Jr. Sep. 1980 75 p refs
(Contract DAAG29-78-C-0029)
(AD-A090137; ARO-15646.4-EL; ITR-2) Avail: NTIS HC A04/MF A01 CSCL 20/14

The basic theory and equations have been derived to describe the radiation characteristics of a wideband CW or pulsed antenna from measured near-field data and to describe the electromagnetic coupling characteristics of a near-field, cosited pair of wideband CW or pulsed antennas. The theory and equations are applicable for both in-band and out-of-band situations and for stochastic as well as deterministic processes. Numerical simulations have been conducted to validate the analytical results and gain insight into the general behavior of the radiation and coupling characteristics of CW antennas. GRA

N81-11294# Florida Univ., Gainesville. Dept. of Engineering Sciences.
REFLECTANCE OF SNOW AT MILLIMETER WAVELENGTHS Final Report
R. C. Anderson and K. I. MacFeely 4 Mar. 1980 46 p refs
(Grant AF-AFOSR-3415-77; AF Proj. 2301)
(AD-A089742; AFOSR-80-0750TR) Avail: NTIS HC A03/MF A01 CSCL 17/9

Radar cross sections of ground snow were calculated for linearly polarized incident radiation at 8.6, 17, 35, and 95 GHz. The snow was modeled as a plane parallel medium consisting of ice grains mixed with varying amounts of liquid water. Individual ice grains were treated as independent Rayleigh scattering centers and the water as a homogeneous absorbing medium. Calculations of the radar cross section were made using known solutions of the radiative transfer equation. These were then compared with experimental data. Curves are given which can be used to find the radar cross section given the grain size and the water content of the snow. GRA

N81-11295# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical Engineering.
SPREAD SPECTRUM OPTICAL SIGNAL PROCESSORS Interim Report
David Casasent and Demetri Psaltis 1980 11 p refs
(Contract AF-AFOSR-0091-79; AF Proj. 2305)
(AD-A089820; AFOSR-80-0861TR) Avail: NTIS HC A02/MF A01 CSCL 17/2

The features and uses of different optical signal processor architectures for diverse spread spectrum applications are reviewed and several new optical system architectures and applications are described. GRA

N81-11296# Clarkson Coll. of Technology, Potsdam, N.Y. Dept. of Electrical and Computer Engineering.
MODELING OF SHADOWS IN RADAR CLUTTER Final Technical Report, 1 Jun. - 31 Dec. 1979

Bruce A. Black, Mohammed Arozullah, and William Ladew Jul. 1980 114 p refs
(Contract F30602-78-C-0102)
(AD-A089702; RADC-TR-80-238) Avail: NTIS HC A06/MF A01 CSCL 17/9

Investigated was the applicability of the Forgy-Jancey and minimum spanning tree clustering algorithms to the problem of locating and characterizing shadowed regions in ground clutter. Certain preprocessing techniques were also investigated for reducing the amount of data prior to clustering. The two clustering algorithms were applied to both simulated and actual radar data, the latter provided by the Signal Processing Laboratory at RADC. The algorithms were run on the IBM 360/65 at Clarkson College using programs either written at Clarkson or obtained from the pattern recognition package ARTHUR. The Forgy-Jancey algorithm was found to be flexible and capable of handling large data sets at moderate cost, but was inconsistent in its ability to detect the 'natural' clusters in unknown data. The minimum spanning tree algorithm was more reliable in this regard, but the ARTHUR implementation was found to be costly in terms of required storage. The report contains numerous figures illustrating the application of the two clustering algorithms to various configurations of data. Clustering techniques appear to hold promise for examining the structure of unknown clutter data, but the results must be interpreted with care, since a natural clustering is not always found. GRA

N81-11297# National Communications System, Washington, D. C. Office of Technology and Standards.
EMP VULNERABILITIES OF TELECOMMUNICATIONS FACILITIES AND THEIR RELEVANCE TO EMP PROTECTION STANDARDS Final Report
Chadwick Stansberry Jun. 1980 47 p refs
(AD-A089772; AD-E100395; NCS-TIB-80-3) Avail: NTIS HC A03/MF A01 CSCL 17/2

This report identifies and categorizes the reasons for High Altitude Electromagnetic Pulse (HEMP) vulnerability of terrestrial communication equipment and systems for leased and government owned stations in both manned and unmanned categories. GRA

N81-11298# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
EFFICIENT ACCESSING OF A MULTIACCESS CHANNEL
Pierre A. Humblet and Jeannine Mosely Sep. 1980 7 p refs Presented at the 19th IEEE Conf. on Decision and Control, Albuquerque, N. Mex., 10-12 Dec. 1980
(Contract N00014-75-C-1183; Grant NSF ECS-79-19880; DARPA Order 3045; NR Proj. 049-383)
(AD-A089841; LIDS-P-1040) Avail: NTIS HC A02/MF A01 CSCL 17/2

A discrete time multiaccess channel is considered where the outcome of a transmission is either idle, success, or collision, depending on the number of uses transmitting simultaneously. Messages involved in a collision must be retransmitted. An efficient access allocation policy is developed for the case where infinitely many sources generate traffic in a Poisson manner and can all observe the outcomes of the previous transmissions. Its rate of success is .488. Modifications are presented for the cases where the transmission times depend on the transmission outcomes and where observations are noisy. GRA

N81-11299# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
A CLASS OF OPTIMAL ROUTING ALGORITHMS FOR COMMUNICATION NETWORKS
Dimitri P. Bertsekas Sep. 1980 17 p refs Presented at the ICCC 80 Conf., Atlanta, Oct. 1980
(Contract N00014-75-C-1183; Grant NSF ENG-79-06332; ARPA Order 3045; NR Proj. 049-383)
(AD-A089840; LIDS-P-1042) Avail: NTIS HC A02/MF A01 CSCL 17/2

This report describes an algorithm for minimum delay routing in a communication network. During the algorithm each node maintains a list of paths along which it sends traffic to each destination together with a list of the fractions of total traffic that are sent along these paths. At each iteration a minimum marginal delay path to each destination is computed and added to the current list if not already there. Simultaneously the corresponding fractions are updated in a way that reduces average delay per message. The algorithm is capable of employing second derivatives of link delay functions thereby providing automatic scaling with respect to traffic input level. It can be implemented in both a distributed and a centralized manner, and it can be shown to converge to an optimal routing at a linear rate. GRA

N81-11300# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
EVENT COMPRESSION USING RECURSIVE LEAST SQUARES SIGNAL PROCESSING M.S. Thesis
Webster Pope Dove Jul. 1980 155 p refs
(Contract N00014-75-C-0951; Grants NSF ENG-76-24117; NSF ECS-79-15226; NR Proj. 049-328)
(AD-A089785; TR-492) Avail: NTIS HC A08/MF A01 CSCL 17/9

This work presents a technique for time compressing the events in a multiple event signal using a recursive least squares adaptive linear prediction algorithm. Two event compressed signals are extracted from the update equations for the predictor; one based on the prediction error and the other on the changes in the prediction coefficients as the data is processed. Using synthetic data containing three all-pole events, experiments are performed to illustrate the performance of the two signals derived from the prediction algorithm. These experiments examine the effects of initialization, white gaussian noise, interevent interference, filtering and decimation on the compressed events contained in the two signals. GRA

N81-11301# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
DATA COMMUNICATION NETWORKS AND INFORMATION THEORY
Pierre A. Humblet Sep. 1980 8 p refs Presented at the Natl. Telecommunication Conf., Houston, Tex., 30 Nov. - 4 Dec. 1980
(Contract N00014-75-C-1183; Grant NSF ECS-79-19880; ARPA Order 3045; NR Proj. 049-383)
(AD-A089839; LIDS-P-1035) Avail: NTIS HC A02/MF A01 CSCL 17/2

Some contributions of information theory to the study of data communication networks are outlined. Special attention is given to the problem of efficient message addressing and to the capacity of Aloha-like multiple access channels with an infinite number of sources. E.D.K.

N81-11302# Mississippi State Univ., Mississippi State.
THE SINGULARITY EXPANSION METHOD APPLIED TO PERDENDICULAR CROSSED WIRES OVER AN IMPERFECT GROUND PLANE, A SOMMERFELD INTEGRAL FORMULATION Interim Report
Terry T. Crow, Jhi-Chung Kuo, and Clayborne D. Taylor Jan. 1980 31 p refs
(Grant AF-AFOSR-3667-78; AF Proj. 2301)
(AD-A089741; AFOSR-80-0749TR) Avail: NTIS HC A03/MF A01 CSCL 20/3

The singularity expansion method (SEM) has been applied to determine natural resonances of a horizontal wire and perpendicular crossed wires oriented over an imperfect ground plane. In order to account for the imperfect conductivity of the ground, the Sommerfeld formulation is used and a theoretical-numerical solution obtained. Sample results are presented for both the frequency domain and the SEM solutions. GRA

N81-11303# Defense Nuclear Agency, Washington, D.C. Radiation and Atmospheric Effects Div.
RADIO WAVE PROPAGATION IN STRUCTURED IONIZATION FOR SATELLITE APPLICATIONS Progress Report, 1 Aug. 1978 - 1 Dec. 1979
Leon A. Wittwer 31 Dec. 1979 71 p refs
(AD-A089715; DNA-5304D) Avail: NTIS HC A04/MF A01 CSCL 20/14

Methods are presented which permit the calculation of signal structure properties of satellite signals as they propagate through structured ionization. The primary parameters are the signal decorrelation time, the frequency selective bandwidth, the mean square log amplitude fluctuation, and the mean square arrival angle of the signal. The form of the generalized power spectrum,

which characterizes the arriving signal as a function of frequency and delay, is specified in terms of the calculated signal structure parameters. Finally, methods are discussed to generate using Monte Carlo techniques signal structures from the generalized power spectrum. GRA

N81-11304# Los Alamos Scientific Lab., N. Mex.
SIGNAL ENHANCEMENT BY SPECTRAL EQUALIZATION OF HIGH FREQUENCY BROADBAND SIGNALS TRANSMITTED THROUGH OPTICAL FIBERS
Peter B. Lyons, James W. Ogle (Edgerton, Germeshausen and Grier, Inc., Goleta, Calif.), and Melvin A. Holzman 1980 5 p refs
(Contracts W-7405-eng-36; DE-AC08-76NV-01183)
(LA-UR-80-1830; CONF-800924-1) Avail: NTIS HC A02/MF A01

A technique is discussed for enhancing the bandwidth and intensity of high frequency analog, spectrally broad signals transmitted through one kilometer of optical fiber. The existing method for bandwidth enhancement of such a signal uses a very narrow filter between the fiber and detector to limit bandwidth degradation due to material dispersion. Using this method, most of the available optical intensity is rejected and lost. This technique replaces the narrow band filter with a spectral equalizer device which uses a reflection grating to disperse the input signal spectrum and direct it onto a linear array of fibers. DOE

N81-11305# Los Alamos Scientific Lab., N. Mex.
RADIO-FREQUENCY QUADRUPOLE: GENERAL PROPERTIES AND SPECIFIC APPLICATIONS
R. H. Stokes, K. R. Crandall, R. W. Hamm, F. J. Humphry, R. A. Jameson, E. A. Knapp, J. M. Potter, G. W. Rodenz, J. E. Stovall, D. A. Swenson et al 1980 7 p refs Presented at 11th Intern. Conf. on High Energy Accelerators, Geneva, 7-11 Jul. 1980
(LA-UR-80-1855; CONF-800740-8) Avail: NTIS HC A02/MF A01

The general properties of radio frequency quadrupole accelerators are reviewed and beam dynamics simulation results are presented for their use in a variety of accelerating systems. The low-beta sections of the Fusion Materials Irradiation Test Accelerator, a 200 MHz proton linear accelerator, and a xenon accelerator for heavy ion fusion are included. DOE

N81-11306# Stanford Linear Accelerator Center, Calif.
ELECTROMAGNETIC FIELDS IN AN AXIAL SYMMETRIC WAVEGUIDE WITH VARIABLE CROSS SECTION
S. Kheifets Jul. 1980 6 p refs Presented at 11th Intern. Conf. on High Energy Accelerators, Geneva, 7-11 Jul. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-PUB-2547; PEP-Note-331) Avail: NTIS HC A02/MF A01

A new class of separable variables was found which allows one to find an approximate analytical solution of the Maxwell equations for axial symmetric waveguides with slow (but not necessarily small) varying boundary surfaces. An example of the solution is given. Possible applications and limitations of this approach are discussed. DOE

N81-11307# Sandia Labs., Albuquerque, N. Mex.
ADMITTANCE OF AN INFINITELY LONG MONOPOLE ANTENNA IMMERSED IN A DISSIPATIVE MEDIUM AND DRIVEN BY A COAXIAL LINE WITH A NONDISSIPATIVE DIELECTRIC BEAD IN THE END
M. E. Morris May 1980 47 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-1490) Avail: NTIS HC A03/MF A01

The effect of an electrically thin nondissipative dielectric bead on the admittance of the monopole antenna is quantified by numerically solving the coupled pair of singular integral equations that result from formulating the corresponding infinite antenna problem as a rigorous boundary value problem. The findings based on the calculations are: (1) even very thin beads can affect measurement of admittances significantly in experimentally realizable situations; (2) the correction to the admittances is capactive (imaginary and proportional to frequency) for thin beads; (3) the capacitive correction term is proportional to the thickness of the bead if the outer diameter of the bed is the same diameter as the air-filled coaxial line; and (4) matching the characteristic impedance of the air-filled portion of the coaxial line to that of the dielectric bead portion of the line is not particularly helpful in the interpretation of experimental data. DOE

N81-11308# Sandia Labs., Albuquerque, N. Mex.
MICROCOMPUTER CLOSED CIRCUIT TELEVISION CONTROLLER
Charles H. Kinsey and Leon W. Maschoff Jul. 1980 59 p refs Sponsored in part by AFSC, Hanscom AFB, Mass.
(Contract DE-AC04-76DP-00789)
(SAND-79-0688) Avail: NTIS HC A04/MF A01

A controller was developed for the perimeter surveillance system closed circuit television. Its prime function is to decode perimeter sensor alarm data and alert the operator so he can assess it over closed circuit television. It also warns the operator of link failures and provides a surveillance feature that sequentially displays all on line camera data. A minimum configuration includes 160 sensors, 10 sensor sectors, 20 cameras, and 5 display monitors. DOE

N81-11309# Sandia Labs., Albuquerque, N. Mex. Applied Biology and Isotope Utilization Div.
ADMITTANCE OF AN INFINITELY LONG MONOPOLE ANTENNA DRIVEN BY A COAXIAL LINE
Marvin E. Morris May 1980 76 p refs
(Contract DE-AC04-76DP-00789)
(SAND-78-1065) Avail: NTIS HC A05/MF A01

The admittance of a coaxially-driven infinite monopole over an infinite ground plane is accurately calculated for a wide range of parameters. Differences of these admittances can be added or subtracted to correct for drive geometry changes in finite antennas that are not too short. DOE

N81-11981*# Alabama Univ. at Huntsville. Dept. of Physics.
PILOT SIGNALS FOR LARGE ACTIVE RETRODIRECTIVE ARRAYS
C. H. Chan *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 17 p refs (For primary document see N81-11977 02-99)
(Grant NGT-01-002-099)
Avail: NTIS HC A99/MF A01 CSCL 20N

N81-12005*# Mississippi Univ., University.
FFT METHODS IN SIGNAL PROCESSING OF THE COAL INTERFACE DETECTOR RADAR
Darko Kajfez *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 18 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 17I

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N81-11310 Stanford Univ., Calif.
IONIC CONDUCTORS BASED ON LITHIUM ORTHOSILICATE AND RELATED STRUCTURES Ph.D. Thesis
Yaw Wen Hu 1980 241 p
Avail: Univ. Microfilms Order No. 8024678

Solid solutions of lithium orthosilicate and the following compounds: lithium orthophosphate, lithium sulphate and lithium orthoaluminate were synthesized by mixing the individual compounds and firing at high temperatures. X-ray powder diffraction data indicate that there are basically two types of structures, different only by a minor change in the crystal structure symmetry of the lithium silicate type and the lithium phosphate type of structure. Conductivity measurements were made on pellets hot pressed from the powders of the solid solutions. The ionic

conductivity behavior of those solid solutions was found to depend on their structure. For those solid solutions with the lithium orthosilicate types of structure: the ionic conductivity is characterized with a constant pre-exponential factor and a decreasing activation enthalpy, with increased concentration of the dopants. For those solid solutions with the lithium orthophosphate type of structure both the pre-exponential factor and the activation enthalpy of the ionic conductivity change with the composition. Dissert. Abstr.

N81-11311 Stanford Univ., Calif.
APPLICATION OF AC TECHNIQUES TO KINETIC STUDIES OF ELECTROCHEMICAL SYSTEMS Ph.D. Thesis
Chun Ho 1980 244 p
Avail: Univ. Microfilms Order No. 8024675

The advantages of alternating current techniques over alternative transient measurements are discussed in terms of simpler data acquisition, and data analysis and interpretation. In solid electrolyte systems, both single crystal beta-lead fluoride and several lithium ionic conductors were studied by measurements of the complex impedance over a wide range of temperature and frequency. In each system, the frequency dispersion of the resistance and admittance was analyzed, and an equivalent circuit containing temperature and frequency-independent components proposed. The frequency-independent bulk conductivity, interface contribution and grain boundary effects were extracted. The small signal AC technique was applied to a kinetic study of a thin film electrode, tungsten trioxide, by measuring the complex impedance at room temperature as a function of frequency from 5 x 10 to the - 4 power Hz to 5 x 10 to the 3rd power Hz at various open circuit voltage. The chemical diffusion coefficient, the component diffusion coefficient, the partial ionic conductivity of lithium and the thermodynamic enhancement factor of lithium tungsten bronze were obtained. The rate determining steps at short times or at long times was also identified. Dissert. Abstr.

N81-11312 Michigan Univ., Ann Arbor.
A NOVEL SUBMICRON-GATE GaAs MESFET FABRICATION TECHNIQUE Ph.D. Thesis
Thomas Nelson Jackson 1980 114 p
Avail: Univ. Microfilms Order No. 8025698

A technique for producing submicron gate length GaAs MESFETs was developed. The technique does not require electron beam or other exotic lithographic techniques, but uses conventional photolithography and a selective edge plating step. In this step metal is plated to the edge of a conventionally patterned metal layer. This plated edge is then used as a mask for subsequent plasma etching of underlying conductors or dielectrics. This technique has produced lines with widths as small as 0.04 micrometer and MESFET gates as short as 0.1 micrometer. The performance of GaAs MESFETs with gates produced in this manner is comparable to that of devices fabricated using more complex and expensive gate patterning techniques. The plated gate technique was extended to the fabrication of low gate resistance, short gate GaAs MESFETs for low noise applications. In this case the plated gate line is used as a mask for ion milling gold gate material. Gate height to length ratios greater than one are possible yielding low gate resistance. Dissert. Abstr.

N81-11313 Minnesota Univ., Minneapolis.
NOISE IN SILICON FETS AND AMORPHOUS SILICON RESISTORS Ph.D. Thesis
Suk Ki Kim 1980 148 p
Avail: Univ. Microfilms Order No. 8025467

Generation-recombination noise and hot electron noise in JFET's were measured. At low temperature, since not all the donors were ionized there were G-R processes, but their activation energy was lower than at low field values. This can be explained by Poole-Frenkel effect. Near room temperature, thermal noise or hot electron noise was observed. Hot electron noise in MOSFET's was measured. G-R noise due to donor centers was observed in this case, since there were no donors in the channel. Finally, noise in amorphous silicon resistors was measured at high temperature since the resistance of the samples was so high at room temperature. Dissert. Abstr.

N81-11314*# TRW Defense and Space Systems Group, Redondo Beach, Calif. Power Conversion Electronics Dept.
USER'S DESIGN HANDBOOK FOR A STANDARDIZED CONTROL MODULE (SCM) FOR DC TO DC CONVERTERS, VOLUME 2 Final Report, Jun. 1976 - Jan. 1980
Fred C. Lee (Virginia Polytechnic Inst. and State Univ.) Apr. 1980 162 p refs Prepared by Virginia Polytechnic Inst. and State Univ.
(Contract NAS3-20102)
(NASA-CR-165173; TRW-29922-6001-RU-01-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 09C

A unified design procedure is presented for selecting the key SCM control parameters for an arbitrarily given power stage configuration and parameter values, such that all regulator performance specifications can be met and optimized concurrently in a single design attempt. All key results and performance indices, for buck, boost, and buck/boost switching regulators which are relevant to SCM design considerations are included to facilitate frequent references. A.R.H.

N81-11315*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODULAR INSTRUMENTATION SYSTEM FOR REAL-TIME MEASUREMENTS AND CONTROL ON RECIPROCATING ENGINES
William J. Rice and Arthur G. Birchenough Nov. 1980 14 p refs
(NASA-TP-1757; E-455) Avail: NTIS HC A02/MF A01 CSCL 14B

An instrumentation system was developed for reciprocating engines. Among the parameters measured are the indicated mean effective pressure, or theoretical work per cycle, and the mass fraction burn rate, a measure of the combustion rate in the cylinder. These computations are performed from measured cylinder pressure and crankshaft angle and are available in real time for the experimenter. A 100 or 200 consecutive-cycle sample is analyzed to reduce the effect of cyclic variations in the engine. Data are displayed in bargraph form, and the mean and standard deviation are computed. Other instruments are also described. Author

N81-11316# JAYCOR, Alexandria, Va.
ELECTRON AND ION FLOWS IN DIODES Final Report, 19 Mar. 1979 - 18 Jun. 1980
Shyke A. Goldstein, Paul F. Ottinger, Robert J. Barker, and Robert A. Meger 19 Aug. 1980 42 p
(Contract N00014-79-C-0177)
(AD-A089736; JAYCOR-TPD200-80-008-FR) Avail: NTIS HC A03/MF A01 CSCL 20/9

The three subjects, small size diodes (1 mm) in order to generate very large ion current density, medium size diodes (10 cm) for efficient ion beam generation via the Pinch Reflex Diode, and large diodes (approx. 1 m) were the principal areas investigated and are concentrated on in this report. In particular, this report explains the physics of the backscatter diode and how a runaway phenomenon can generate very large current density ion beams which could be used in beam target studies. There follows an examination of the physics of how anode plasmas are generated using various materials and the question of electron flow in a pinch-reflex diode (PRD). The report ends with a review of the role of electron and ion flows in large area diodes driving plasma loads. GRA

N81-11317# IBM Watson Research Center, Yorktown Heights, N.Y.
STUDY OF THE PHYSICS OF INSULATING FILMS AS RELATED TO THE RELIABILITY OF METAL OXIDE SEMICONDUCTOR DEVICES Interim Report, 1 Apr. - 30 Sep. 1979
D. J. Dimaria, D. W. Dong, R. Ghez, E. A. Irene, and E. Tierney May 1980 208 p refs
(Contract F19628-78-C-0225; ARPA Order 2180)
(AD-A089704; RADC-TR-80-170) Avail: NTIS HC A10/MF A01 CSCL 09/1

This work includes a study of the morphology associated with the oxidation of polycrystalline silicon, a description of moderate field charge injectors using silicon rich SiO2, a technique for studying trapping characteristics using these charge injectors and a review paper on radiation damage in SiO2. GRA

N81-11318# Hughes Aircraft Co., Torrance, Calif.
HIGH EFFICIENCY DEFLECTION MODULATED MICROWAVE GENERATOR STUDY Final Technical Report, Feb. 1979 - Feb. 1980
T. Wessel-Berg and I. Tammaru Jul. 1980 114 p refs
(Contract F30602-79-C-0089)
(AD-A090027; W-08322; RADC-TR-80-211) Avail: NTIS HC A06/MF A01 CSCL 09/5

This report describes a study of the deflection of the system in deflection modulated microwave generators (gyrocons). A general deflection theory was developed, based on a relativistic beam formulation and a first order expansion of Maxwell's field equations. It includes the effect of dc space charge forces on the beam size as well as a distortion of the beam cross section due to the RF interaction. The theory was applied to cavities with electric deflection fields. Such cavities were experimentally evaluated by cold tests and appear to be superior to the commonly used magnetic deflection cavities. A unique design approach makes it possible to achieve a circular beam deflection with a single RF signal. Multicavity deflection systems, in which the input cavity is followed by floating cavities that are excited by the deflection modulated beam, can provide high gain, typically 50-55 dB with three cavities. General design curves relating optimum beam perveance to other operating parameters and desired conditions at the output ring resonator were derived, but the output cavity itself was not part of the study. GRA

N81-11319# Honeywell Systems and Research Center, Minneapolis, Minn.
UNIT UNDER TEST SIMULATOR FEASIBILITY STUDY Final Technical Report
Stephen J. Nuspl, David T. Lee, John P. Hudson, and Todd C. Steeves Jun. 1980 270 p refs
(Contract F33615-79-C-1811; AF Proj. 2003)
(AD-A090178; HONEYWELL-80SRC46; AFWAL-TR-80-1091) Avail: NTIS HC A12/MF A01 CSCL 14/2

This report addresses the use of a Unit Under Test (UUT) simulator as a potential solution for supporting the verification and validation (V V) of test programs for automatic test equipment (ATE). The objectives are to increase the effectiveness of the verification and validation and to reduce development costs. The study approach involved a top-down look at the nature of the problem and a bottom-up look at the techniques and technologies that could be applied to realize a UUT simulator. The recommended solution is based on multiple levels of simulation and uses either an instrument bus interface to the test equipment or a software-only-based interface to the test-program interpreter. Further issues of cost-effectiveness must be addressed for the Modular Automatic Test Equipment (MATE) context. GRA

N81-11320# Maya Development Corp., San Diego, Calif.
A VERY LOW ENERGY ELECTROSTATIC ANALYZER Annual Report, 1 Jan. - 30 Sep. 1978
Robert E. Laquey 31 Dec. 1979 36 p
(Contract F19628-78-C-0012; AF Proj. 2311)
(AD-A090016; SCIENTIFIC-1; AFGL-TR-80-0023) Avail: NTIS HC A03/MF A01 CSCL 09/5

An electrostatic analyzer is described that can be applied to obtaining the differential energy spectrum of very low energy ions or electrons in the energy range 1 to 100 eV. This instrument is designed to operate at magnetic field strengths up to 0.5 Gauss and is adaptable to construction as an array of sensing elements. GRA

N81-11321# University of Southern California, Los Angeles. Center for Laser Studies.
STUDIES OF PYROELECTRICITY IN THIN SAMPLES OF FERROELECTRIC MATERIALS FOR IMPROVED HIGH SPEED INFRARED DETECTORS Final Report, 1 Jun. 1977 - 30 Jun. 1980
Michael Bass and Menahem Simhony 15 Sep. 1980 6 p refs
(Contract DAAG29-79-C-0111; Grant DAAG29-77-G-0147)
(AD-A089958; ARO-14455.5-P) Avail: NTIS HC A02/MF A01 CSCL 17/5

Pyroelectric (PE) detectors made of 10 and 25 micrometers thick samples of PLZT 8/65/35 respond well to megawatt, 50 nsec CO2 laser pulses. Superimposed piezoelectric oscillations have an incubation time, during which they do not disturb the PE response. Edge electroded detectors showed an RC time of 60 picosecond. Poling currents in the samples appear to have components due to space-charge injection and to polaron formation and motion. A method was developed to separate the PE component of the poling current and to measure the PE coefficient under the poling voltage. GRA

N81-11322# Brookhaven National Lab., Upton, N. Y. Metallurgy and Materials Science Div.
METALLURGY OF CONTINUOUS FILAMENTARY A15 SUPERCONDUCTORS
Masaki Suenaga 1980 136 p refs Presented at the NATO Adv. Study Inst. Superconducting Mat.-Sci. and Technol., Lisbon, 19 Aug. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28150; CONF-800839-1) Avail: NTIS HC A07/MF A01

The early history of the bronze process is recapitulated and modifications to the process which have since followed are described. The metallurgical principles, which are involved in the process, are described including the kinetics of the compound growth, the effects of additives on the growth, etc. The superconducting properties of these compounds are also discussed. The influence of metallurgical variables on the superconducting properties is discussed in detail. In discussing the superconducting current densities in these compounds, limits in applicability of existing magnetic flux pinning models are also treated as well as methods for determining critical magnetic fields. DOE

N81-11323# Westinghouse Electric Corp., Pittsburgh, Pa.
TRANSFORMER REQUIREMENTS FOR THE YEAR 2000 Final Report
Jun. 1980 203 p refs
(Contract ET-78-C-01-3291)
(DOE/RA-3291/01) Avail: NTIS HC A10/MF A01

The principal objective of this program was to determine the design parameters required for transformers of the year 2000. The approach to meeting this objective was to determine the changes which may occur in transmission and distribution systems over the next twenty years, and how these changes might affect design parameters of distribution and power transformers. Emphasis was placed on domestic requirements, although the impact of international practices was factored into the overall requirements for transformers. Possible investigations that could help transformer designers meet the long term technical requirements of future transformers were also identified. The principal conclusions of this study were: 1200 kV transmission could be in service by the late 1980's and it is essential to develop 1200 kV transformers for these systems; transformer manufacturers must be prepared to supply higher MVA ratings at all voltage levels; there will be a strong demand for low loss, minimum cost transformers; and environmental/safety, reliability, and size reduction considerations will increase in importance. DOE

N81-11324# Sandia Labs., Albuquerque, N. Mex. Geothermal Technology Div.
THE 250 C THICK-FILM HYBRID MICROCIRCUITRY FABRICATION TECHNOLOGY
Peggy A. Bonn and Dave W. Palmer Jul. 1980 43 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-0078) Avail: NTIS HC A03/MF A01

High temperature electronics is needed for geothermal well logging tools, jet engine monitors, nuclear reactor instruments, and fossil fuel exploration and production systems. The step by step fabrication technology of thick film hybrids useful for at least 1000 hours at 275 C is described. Hybrid technology, qualified to standard military specifications, was modified both in materials and fabrication processes to achieve this high temperature operation. In addition to documenting this technology, various alternate approaches are described to increase the versatility and applicability of these methods. DOE

N81-11325# Los Alamos Scientific Lab., N. Mex.
ELECTROMECHANICAL SHOCK IN PULSE POWER COMPONENTS
T. R. Burkes (Texas Tech Univ., Lubbock, Tex.) and W. J. Sarjeant

1980 9 p refs Presented at 14th Pulse-Power Modulator Symp., Orlando, Fla., 3-5 Jun. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2078) Avail: NTIS HC A02/MF A01

Most components used in high power pulse generators undergo mechanical shock stresses during the pulse or on its leading edge. As power densities become very high, this shock may lead to anomalous behavior as well as introduce failure modes that may not be immediately obvious. It was shown that acoustic shock waves traveling within spark gap electrodes can affect electrode erosion. A new point of view is required for component design where shock may be a critical factor. The mechanisms for generation of shock forces, both thermal and electromagnetic, are reviewed and applied to resistors, capacitors, magnetic devices and switches. The mechanisms described are square law effects and it is concluded that for high energy pulses, mechanical shock stress is a critical factor in component survival. DOE

N81-11326# Sandia Labs., Albuquerque, N. Mex.
SELF-MAGNETICALLY INSULATED ELECTRON FLOW IN VACUUM TRANSMISSION LINES
J. P. VanDevender, J. T. Crow, B. G. Epstein, D. H. McDaniel, C. W. Mendel, Jr., E. L. Neau, J. W. Poukey, J. P. Quintenz, D. B. Seidel, and R. W. Stinnett 1980 46 p refs Presented at 9th Intern. Symp. on Discharges and Elec. Insulations in Vaccum, Eindhoven, 10 Sep. 1980
(SAND-80-1358C; CONF-800923-3) Avail: NTIS HC A03/MF A01

The properties of the electron flow in self magnetically insulated vacuum transmission lines were investigated. An analysis of three basic types of transitions in magnetically insulated lines indicate that beam effects dominate the power transport and electron stability. Faraday cup measurements of the loss current density to the anode show the usual electron component during the rise of the voltage and also a residual loss from negative ions. This low level loss current persists over a small fraction of the total electrode area after the electrons are insulated. The characteristics of the loss are strongly affected by how the plasma is formed. DOE

N81-11327# California Univ., Livermore. Lawrence Livermore Lab.
DASLL: AN AUTOMATIC PRINTED CIRCUIT BOARD LAYOUT SYSTEM
W. G. Magnuson, Jr. 1980 8 p refs Presented at the 1980 IEEE Intern. Conf. on Circuits and Computers, New York, 1-3 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-84640; CONF-801005-2) Avail: NTIS HC A02/MF A01

The design automation system at Lawrence Livermore (DASLL) is a system of computer programs to automatically lay out printed circuit boards. The focus was on two sided PCB fabrication aids; primarily drill tape, documentation, and artwork generation (including etch, silkscreen, and drill schedule artwork). Limited four layer PCBs are also possible with the program. The DASLL can be used in either batch interactive or batch made of operation by technicians, draftsmen, designers, or engineers. Flexibility in being able to accommodate a diversity of trimline geometries and component shapes and placements was a goal in the design of the software. The system is also very flexible in its capability to deal with physical design rules. A principal objective for the system was low volume, quick turnaround response for low and medium density custom printed circuit boards. DOE

N81-11328# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
DETERMINING THE MODE OF HIGH VOLTAGE BREAKDOWNS IN VACUUM DEVICES
H. Craig Miller, E. J. Furno, and J. P. Sturtz 1980 19 p refs Presented at the 9th Intern. Symp. on Discharges and Electrical Insulations in Vacuum, Eindhoven, Netherlands, 16-19 Sep. 1980 Prepared in cooperation with General Electric Co., San Jose, Calif.
(Contract DE-AC04-76DP-00656)
(GEPP-OP-473; CONF-800923-1) Avail: NTIS HC A02/MF A01

Techniques for examining high voltage breakdowns (HVBs) in vacuum devices are discussed. Photography in conjunction with other diagnostic techniques is used to establish the validity of these techniques. The techniques examined are to measure the voltage applied to the device (or the current through the device) and also to look for X-rays generated by the device during an HVB. DOE

N81-11329# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
IMPROVING THE VOLTAGE HOLDOFF PERFORMANCE OF ALUMINA INSULATORS IN VACUUM BY QUASIMETALLIZING OR DOPING
H. Craig Miller 1980 19 p refs Presented at the 9th Intern. Symp. on Discharges and Elec. Insulation in Vacuum, Eindhoven, Holland, 16-19 Sept. 1980
(Contract DE-AC04-76DP-00656)
(GEPP-OP-476; CONF-800903-2) Avail: NTIS HC A02/MF A01

The high voltage holdoff capability of insulators may be improved by changing the material of the insulator or by a proper choice of geometry for the device using the insulator. Treatment of the surface of an alumina insulator with coatings incorporating varying amounts of Cr, Mn, and Ti are found to significantly increase the vacuum voltage holdoff capability of the insulator (up to 25 percent). During processing (quasimetallizing) the coating penetrates into the alumina, so it is insensitive to mechanical damage. This quasimetallize treatment is also compatible with subsequent metallizing and brazing of the alumina insulator. DOE

N81-11330# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
DETERMINING THE MODE OF HIGH VOLTAGE BREAKDOWNS IN VACUUM DEVICES
H. Craig Miller, E. J. Furno, and J. P. Sturtz 11 Aug. 1980 12 p refs
(Contract DE-AC04-76DP-00656)
(GEPP-TIS-473) Avail: NTIS HC A02/MF A01

Vacuum diodes equipped with windows allowing observation of high voltage breakdowns were constructed. The waveform of the applied voltage was photographed, and the X-ray output was monitored to investigate electrical breakdown in these vacuum diodes. Breakdowns may be divided into types: (1) vacuum (interelectrode) breakdown - characterized by a diffuse moderately bright discharge, a relative slow and smooth voltage collapse, and a large burst of X-rays; and (2) surface (insulator) flashover - characterized by a bright discharge with a very bright filamentary core, a relatively fast and noisy voltage collapse and no X-ray burst. DOE

N81-11331# General Electric Co., Schenectady, N. Y.
FUNDAMENTAL INVESTIGATION OF ARC INTERRUPTION IN GAS FLOWS Final Report
D. M. Benenson, G. Frind, R. E. Kinsinger, H. T. Nagamatsu, H. O. Noeske, and R. E. Sheer, Jr. Jul. 1980 231 p refs
(EPRI-EL-1455) Avail: NTIS HC A11/MF A01

Thermal recovery in gas blast interrupters is discussed. The thermal recovery process was investigated with physical and aerodynamic methods, typically using reduced size nozzles and short sinusoidal current pulses. Aerodynamic characterization of the cold flow fields in several different nozzle types included measurements of the pressure and flow fields, both steady-state and turbulent components, with special attention given to wakes and shock structures. Special schlieren techniques on DC arcs and high speed photography on arcs in orifice nozzles show that shock heating broadens the arc independent of turbulence effects and produces a poorly recovering downstream arc section. Measured recovery speeds in both orifice and convergent-divergent nozzles agree with predictions of several arc theories assuming turbulent power losses. However, data on post-zero currents and power loss show values much smaller than theoretical predictions. Hydrogen, deuterium, and methane were measured. DOE

N81-11332# Power Technologies, Inc., Schenectady, N. Y.
DETERMINATION OF SYNCHRONOUS MACHINE STABIL-

ITY STUDY CONSTANTS Final Report
F. P. deMello and L. N. Hannett Jun. 1980 385 p refs
(EPRI-EL-1424-Vol-3) Avail: NTIS HC A17/MF A01

Test methods for derivation of model parameters and validation of synchronous machine model structures for use in stability studies were investigated. The period of performance was April 1977 to December 1979. The conclusions are: (1) (1) load rejection tests are practical and provide good data for derivation of machine model parameters, and for verification of adequacy of model structures; (2) state of the art second order model structures for both the d and q axis are adequate for the representation of machine flux dynamics in response to stator currents and modifications of the d axis model are needed to properly represent field current transients that are affected by rotor iron effects; and (3) improvements in saturation representation seem to offer the greatest potential for gains in machine model accuracy. DOE

N81-11333# Habirshaw Cable and Wire Corp., Yonkers, N. Y. Research and Development Center.
IMPREGNATION OF SOLID DIELECTRIC CABLE INSULATION
K. D. Kiss, D. Mangaraj, H. C. Doepken, Jr., M. C. Biskeborn, E. Malawer, A. L. McKean, and K. Tsuji Jul. 1980 285 p refs (EPRI Proj. 7854)
(EPRI-EL-1435) Avail: NTIS HC A13/MF A01

Laboratory scale investigations, conducted to assess the feasibility of improving the dielectric characteristics of crosslinked polyethylene insulated cables rated 138 kV and above, are discussed. Impregnation of slabs cut from 138 kV cables and of model cables with liquids increased the ac breakdown strength, presumably by filling the microvoids (and possibly in some cases acting as a boltage stabilizer) and preventing premature failure due to electrical discharge. The degree of improvement depends on the chemical nature of the impregnant. Vinyl toluene, styrene, styrene oxide, and vinyl pyrrolidone were found to increase the dielectric strength substantially and in some cases improve the VT curve. Optical and scanning electron microscopic examination supports the concept of void filling. An economic analysis including raw materials' costs and manufacturing costs suggests that the process of impregnation and polymerization costs somewhat less than lead sheathed, dry cured power cables. DOE

N81-11334# Department of Energy, Washington, D. C.
ANALYSIS OF ELECTROMAGNETIC PROCESSES AND ENERGY LOSSES IN A SELF-CONTAINED dc ELECTRIC TRACTION MOTOR WITH PULSE-FREQUENCY AND PULSE-WIDTH CONTROL
Yu. N. Chekhovoy 1979 8 p Transl. into ENGLISH from 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 Conf. held in Erevan, USSR, 1979
(DOE-Tr-237) Avail: NTIS HC A02/MF A01

A design in which the voltage from the storage battery (SB) is converted by a power pulse converter (PPC) into a pulse train modulated in frequency and width is described. Pulse width modulation (PWM) serves to regulate the mean voltage applied to the motor armature, while pulse-frequency modulation (PFM) is used as an additional optimizing influence. DOE

N81-11335# Department of Energy, Washington, D. C.
SELF-CONTAINED INVERTERS WITH PULSE-WIDTH VOLTAGE REGULATION FOR AN AC ELECTRIC DRIVE IN AN ELECTRIC PASSENGER AUTOMOBILE
V. A. Labuntsov and V. A. Zheglov 1979 10 p Transl. into ENGLISH from Russian Meeting Presented at Second Soviet-Am. Symp. on Elec. Automobiles, Erevan, USSR, 1979
(DOE-TR-238) Avail: NTIS HC A02/MF A01

The use of traction asynchronous motors (TAM) with frequency control in place of dc motors is a promising trend in the development of electric automobiles. Work is under way to develop thyristor inverters which will make it possible to regulate the speed and electromagnetic moment of a TAM powered from a non-regulated dc source, a storage battery. In order to form the required traction characteristics of the electric automobile when accelerating, moving at reduced speeds, etc. it is necessary to regulate both the frequency and value of the voltage applied to the motor. The use of inverters with PWR in an electric automobile makes it possible to eliminate a separate voltage regulator in the dc circuit from the main power circuit system. The possibility is examined for controlling the speed of an electric automobile with a TAM by using self-contained voltage inverters with pulse-width regulation of the output voltage while changing its frequency within a broad range, which is one of the primary requirements for an electric drive in an electric automobile. DOE

N81-11336# Oak Ridge National Lab., Tenn.
HIGH VOLTAGE RESEARCH, BREAKDOWN STRENGTHS OF GASEOUS AND LIQUID INSULATORS, AND ENVIRONMENTAL EFFECTS OF DIELECTRIC GASES Semiannual Report, 1 Oct. 1979 - 31 Mar. 1980
L. G. Christophorou, D. R. James, R. Y. Pai, R. A. Mathis, I. Savers, D. H. Smith, L. Frees, M. O. Pace, D. W. Bouldin, C. C. Chan et al Aug. 1980 117 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7405) Avail: NTIS HC A06/MF A01

Topics covered include basic studies of gaseous dielectrics, direct current breakdown strengths of gases/mixtures, environmental effects studies and decomposition analyses, impulse studies, breakdown strengths of binary mixtures with concentric cylinder geometry, and a discussion of the experimental apparatus. DOE

N81-11337# Bendix Corp., Kansas City, Mo.
PLASMA ETCHBACK OF MULTILAYER PRINTED WIRING BOARDS
F. L. Gentry Jun. 1980 17 p
(Contract DE-AC04-76DP-00613)
(BDX-613-2458) Avail: NTIS HC A02/MF A01

Removal of epoxy smear and glass fiber protrusions in multilayer printed wiring board holes was investigated. Gas plasma techniques, using a mixture of carbon tetrafluoride and oxygen, removed the eposies; however, the glass fibers were not affected. DOE

N81-11338# Bendix Corp., Kansas City, Mo.
IMPROVED TECHNIQUES TO MONITOR THIN FILM CHARACTERISTICS FOR RELIABLE HYBRID MICROCIRCUIT FABRICATION
N. C. Thomas and L. R. Zawicki Aug. 1980 23 p Presented at the ISHM Ann. Meeting, N.Y., 20-22 Oct. 1980
(Contract DE-AC04-76DP-00613)
(BDX-613-2478; CONF-801024-2) Avail: NTIS HC A02/MF A01

Improved testing techniques for monitoring thin film product characteristics and process control were developed primarily to provide a real time, full process monitor to test thin film adhesion and to evaluate thin film properties under accelerated aging. Additionally, more cost effective methods were developed to monitor process control through measurement of film properties that relate directly to key process variables. A special circuit pattern was designed to offer improved information gathering capabilities. This pattern is now included on the corner of production substrates to monitor thin film adhesion, via resistance, and resistor film temperature coefficient of resistance, and life stability. Minicomputer hardware and software were developed to monitor thin film interface resistance changes under accelerated aging conditions of elevated temperature, high humidity, and corrosive environments. Curves for different aging characteristics were developed for different thin film metallization systems and for some process and substrate variables. DOE

N81-11339# Bendix Corp., Kansas City, Mo.
CURE CYCLE EVALUATION FOR MULTILAYER PRINTED WIRING BOARDS
J. W. Lula Jun. 1980 16 p refs
(Contract DE-AC04-76DP-00613)
(BDX-613-2392) Avail: NTIS HC A02/MF A01

The cure cycle for multilayer printed wiring boards made from general purpose, fire retardant epoxy/glass materials was evaluated for the optimum delamination resistance at soldering temperatures. For the epoxy resin system used to manufacture multilayer PWBs, a wide range of cure cycle variations has a minimal effect on delamination resistance. DOE

N81-11340# National Bureau of Standards, Washington, D.C. National Engineering Lab.

SEMICONDUCTOR TECHNOLOGY PROGRAM: PROGRAM BRIEFS Interim Report, Jan. - Mar. 1980
W. Murray Bullis Jun. 1980 13 p refs Sponsored in part by DOE, Washington, D.C., Defense Nuclear Agency, Washington, D.C. and Charles Stark Draper Lab., Inc., Cambridge, Mass.
(ARPA Order 2397)
(PB80-207038; NBSIR-80-2006-2) Avail: NTIS HC A02/MF A01 CSCL 09A

Measurement technology for semiconductor materials, process control, and devices are discussed. Highlighted activities include: studies of MOSFET dc profiler, heavy doping effects in silicon, process validation wafer applications, ion-implanted dopant profiles, optical linewidth measurements on wafers, process-induced radiation damage, translator switching characteristics, and acoustic emission testing. Brief descriptions of selected on-going projects are included, and recent publications and publications in press are listed. GRA

N81-11997*# Athens Coll., Ala.
PULSED EDDY CURRENT TESTING
Gary L. Workman *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 18 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N81-11341*# Polytechnic Inst. of New York.
EXPERIMENTS ON INITIAL AND BOUNDARY CONDITIONS
Gino Moretti 1980 11 p refs Workshop held in Stockholm, 18-19 Sep. 1979
(Grant NsG-1248)
(NASA-CR-163711) Avail: NTIS HC A02/MF A01 CSCL 20D

Effects of three different models for the treatment of subsonic boundary conditions, applied to the problem of flow in a channel with a bump, are discussed. A preliminary discussion of the numerical treatment of the corners is presented. *Author*

N81-11342# Naval Research Lab., Washington, D. C. Lab. for Computational Physics.
SIMULATION OF COMPLEX SHOCK REFLECTIONS FROM WEDGES IN INERT AND REACTIVE GASEOUS MIXTURES ***Interim Report***
D. Book, J. Boris, A. Kuhl (R and D Associates, Marina del Ray, Calif.), E. Oran, M. Picone, and S. Zalesak 30 Sep. 1980 25 p refs
(AD-A090115; NRL-MR-4333) Avail: NTIS HC A02/MF A01 CSCL 19/4

The Flux-Corrected Transport (FCT) technique for solving fluid equations reduces numerical diffusion, permitting calculations with Reynolds numbers considerably in excess of the cell Reynolds number. Recent advances in FCT, including a multidimensional flux limiter and a dynamic adaptive rezone, are illustrated in the problem of transient reflections of planar shocks from wedges in inert and reactive media. Results are obtained with high resolution which are in quantitative agreement with experiments. GRA

N81-11343# *Cincinnati Univ., Ohio. Dept. of Mechanical and* Industrial Engineering.
A REPRESENTATION OF FLUID FORCES FOR USE IN *FINITE SEGMENT* CABLE MODELS Technical Report, 1 Jun. 1979 - 31 Aug. 1980
Ronald L. Huston and James E. Kamman 1 Sep. 1980 37 p refs
(Contract N00014-76-C-0139)
(AD-A090181; UC-MIE-090180-9-ONR) Avail: NTIS HC A03/MF A01 CSCL 13/10

The finite segment modelling of a long flexible cable is discussed. An equivalent force system representing the fluid and gravitational forces exerted on a typical cable segment is determined. The fluid forces include inertia, drag, and hydrostatic (buoyancy) forces. Application of the results in computer algorithm development is also discussed. GRA

N81-11344# Colorado State Univ., Fort Collins. Dept. of Mathematics.
VECTORIZATION OF THE BEAM-WARMING SCHEME ON THE CRAY-1 COMPUTER Final Report
J. W. Thomas Aug. 1980 10 p refs
(Contract F49620-79-C-0121; AF Proj. 2304)
(AD-A090179; AFOSR-80-0863TR) Avail: NTIS HC A02/MF A01 CSCL 20/4

A three-dimensional version of the Beam-Warming scheme for solving the Navier-Stokes equations was implemented on the Cray-1 computer. The scheme is implicit and second-order accurate. The code is totally vectorized, allows for complicated geometries and includes a thin layer turbulence model. GRA

N81-11345# Naval Research Lab., Washington, D. C.
THE SENSITIVITY OF WAVE FORCE COMPUTATIONS TO COMMON ERRORS, UNCERTAINTIES, AND HYDRODYNAMIC APPROXIMATIONS
Steven E. Ramberg and John M. Niedzwecki 10 Sep. 1980 55 p refs
(RR0230141)
(AD-A089853; NRL-MR-4206) Avail: NTIS HC A04/MF A01 CSCL 20/4

The present investigation examines the methods and the hydrodynamic approximations commonly employed in wave force analysis. Alternatives and modifications are sought which improve the resolution of a general Morison approach. This is accomplished by considering two basic arrangements; a vertical cylinder and a horizontal cylinder in progressive waves. The physical differences between the flows are explored and the results are compared to previous planar harmonic flow measurements. It was found that modifications to the usual Morison approach are required to adequately account for the orbital motions of the fluid and to account for the orientation of the orbits with respect to the cylinder axis. The consequences of these findings are discussed for inclined cylinders in waves and for cylinders in short-crested seas. The axial variations of the wave force on vertical cylinders are examined in order to establish error bounds for the common practice of assuming constant values of CM and CD over the entire span. Also, the methods of computing force transfer coefficients from a force record are examined and errors of method are identified and briefly discussed. GRA

N81-11346# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
ON THE CALCULATION OF POTENTIAL FLOW ABOUT A BODY IN AN UNBOUNDED FLUID
Francis Noblesse and George Triantafyllou Sep. 1980 44 p refs
(Contract N00014-78-C-0169; NR Proj. 062-525)
(AD-A089834; Rept-80-8) Avail: NTIS HC A03/MF A01 CSCL 20/4

This study is concerned with the problem of calculating potential flow about a nonlifting body in an unbounded fluid. Several simple explicit approximations for the velocity potential are obtained and investigated numerically. Results of calculations are presented for the simple cases of potential flows due to translations of ellipsoids and ogives. GRA

N81-11347# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
***EXPERIMENTAL AND THEORETICAL STUDY OF HEAT TRANSFER WITH COMBUSTION* Ph.D. Thesis**
Hasan A. Heperkan May 1980 182 p refs
(Contract W-7405-eng-48)
(LBL-10868) Avail: NTIS HC A09/MF A01

The determination of the heat transfer during combustion is reported. A number of experiments were performed in a shock tube to determine the heat flux at the wall. A combustible mixture, 2H2 + O2 + 27Ar, was used as the test gas. The gas was ignited by flected shock wave. A detonation wave was formed

which moved away from the wall while the combustion zone diffused slowly toward the wall. The wall heat flux was determined by utilizing the measurement of the wall temperature variation with respect to time using a thin film platinum resistance thermometer. In addition a determination of the heat flux was also made by solving the conservation equations in the gas boundary layer near the wall. The results yielded values for the location of the combustion zone as a function of time. The combustion zone diffused slowly toward the end wall and then remained at a constant distance away from the wall. DOE

N81-11348# Bechtel Corp., San Francisco, Calif.
SLOSHING OF LIQUIDS IN RIGID ANNULAR CYLINDRICAL AND TORUS TANKS DUE TO SEISMIC GROUND MOTIONS
M. Aslam, W. G. Godden, and D. T. Scalise Jan. 1980 9 p refs
(Contract W-7405-eng-48)
(LBL-10352; CONF-800919-2) Avail: NTIS HC A02/MF A01

Sloshing response and impulsive hydrodynamic pressures in rigid axisymmetric tanks due to horizontal ground motions are predicted by theoretical solutions based on series and finite element analysis. Results are compared with experimental data from model tests conducted on a 20 ft x 20 ft earthquake simulator. DOE

N81-11349# Idaho National Engineering Lab., Idaho Falls. LOFT Test Support Branch
EXPERIMENTAL DATA REPORT FOR TRANSIENT FLOW CALIBRATION FACILITY TESTS IA101, AI102 AND IA103
J. S. Martinell, J. L. Wambach, and H. S. Crapo 10 Mar. 1980 106 p refs
(Contract DE-AC07-76ID-01570)
(EGG-L-0-00-80-114) Avail: NTIS HC A06/MF A01

Thermal hydraulic response data are presented for the transient performance tests of a modular Drag Disc - Turbine transducer rake. The tests were conducted in a system which provided full scale simulation of the pressure vessel and broken loop cold leg piping of the Loss of Fluid Test Facility. A low cell system was used to provide a reference mass flow rate measurement. DOE

N81-11350# Ames Lab., Iowa.
INVERSE RAMAN EFFECT: APPLICATIONS AND DETECTION TECHNIQUES ***Ph.D. Thesis***
Lester James Hughes, Jr. Aug. 1980 145 p refs
(Contract W-7405-eng-82)
(IS-T-892) Avail: NTIS HC A07/MF A01

The processes underlying the inverse Raman effect are qualitatively described by comparing it to the more familiar phenomena of conventional and stimulated Raman scattering. An expression is derived for the inverse Raman absorption coefficient, and its relationship to the stimulated Raman gain is obtained. The power requirements of the two fields are examined qualitatively and quantitatively. The assumption that the inverse Raman absorption coefficient is constant over the interaction length is examined. Advantages of the technique are discussed and a brief survey of reported studies is presented. DOE

N81-11351# Syracuse Univ., N. Y. Dept. of Chemical Engineering and Materials Science.
MECHANISM OF GAS PERMEATION THROUGH POLYMER MEMBRANES Progress Report, 1 Jun. 1979 - 31 Mar. 1980
S. A. Stern, S. S. Kulkarni, and G. R. Mauze 1980 62 p refs
(Contract DE-AS02-78ER-05015)
(DOE/ER-05015/2) Avail: NTIS HC A04/MF A01

The validity of a free-volume model of gas permeation through nonporous polymeric membranes was assessed. Diffusion and solubility coefficients for CO2, C2H4, and C3H8 in polyethylene rods were measured at temperatures from 5 deg to 35 C and at pressures of up to 30 atm. Characteristic free-volume parameters were determined from these data by means of an improved computational technique. The parameters were used to predict permeability coefficients for the transport of the above gases through polyethylene membranes. The theoretical permeability coefficients were found to be in very satisfactory agreement with experimental values obtained from independent permeability measurements. The permeability coefficients for the components of the mixtures were found to be higher than those of the pure gases, as predicted by the free-volume model. DOE

N81-11352# Battelle Pacific Northwest Labs., Richland, Wash.
TURBULENCE SPECTRUM OBSERVED BY A FAST-ROTATING WIND-TURBINE BLADE
J. R. Connell Jun. 1980 35 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3426; UC-60) Avail: NTIS HC A03/MF A01

The spectrum of turbulence encountered by a point on a fast rotating wind turbine blade was shown to be possibly quite different from that measured by a stationary anemometer. The physically reasonable expectations were supported quantitatively by experiments using Pacific Northwest Laboratory's vertical plane anemometer array. The measurements indicated that the blade encounters energy densities in two regions of the turbulence spectrum much different than those seen by stationary anemometers. For typical turbine types and wind conditions, the spectral energy redistribution phenomenon is significant only for turbine blade diameters larger than 10 m. The spectral shift also affects gust statistics for rotting blades; the duration of gusts that are smaller than the diameter of the disk of blade rotation will decrease. Correspondingly, the rise rate will increase by a factor of about ten. DOE

N81-11353# California Univ., Berkeley.
RANDOM CHOICE METHOD FOR CALCULATING FLUID DISPLACEMENT IN A POROUS MEDIUM
N. Albright, C. Anderson, and P. Concus Jun. 1980 12 p refs Presented at 1st BAIL Conf., Dublin, 3 Jun. 1980
(Contract W-7405-eng-48)
(LBL-11086; CONF-800695-1) Avail: NTIS HC A02/MF A01

Multiphase fluid displacement in a porous medium gives rise naturally to the occurrence of steep fronts, for example between different fluids or between regions of differing chemical concentrations. Such fronts pose substantial difficulty for most numerical methods. However, the recently developed random choice numerical method was found capable of following effectively even perfectly sharp fronts. An application to the calculation of immiscible displacement in a petroleum reservoir is discussed, including the effects of capability pressure and gravity. Numerical results of current work for solving a model problem of two phase displacement in two dimensions indicate that the effects of the additional possible interactions of shock and expansion waves permitted by the inclusion of gravity can be handled efficiently within the framework of the random choice method. DOE

N81-11354# Union Carbide Corp., Oak Ridge, Tenn. Theory Development Group.
GAS FLOW IN A CENTRIFUGE
M. H. Berger Jun. 1980 33 p refs
(Contract W-7405-eng-26)
(K/OA-4748) Avail: NTIS HC A03/MF A01

The mathematical relationship between Onsager's pancake equation and the Ekman boundary layer equations is derived by methods of perturbation theory. The so-called internal flow region is shown to be simply the first term in an asymptotic series for the outer expansion. The complementary inner expansion is shown to be the Ekman layer. Some of the more subtle approximations and assumptions on boundary conditions are given attention. DOE

N81-11355# Argonne National Lab., Ill.
CORRELATION AND SPECTRAL MEASUREMENTS OF FLUCTUATING PRESSURES AND VELOCITIES IN AN ANNULAR TURBULENT FLOW
Randall J. Wilson, Barclay G. Jones, and Ramendra P. Roy Feb. 1980 150 p refs Prepared in cooperation with Illinois Univ., Urbana and General Electric Co., San Jose, Calif.
(Contract DE-AC02-77ET-34209; EN-77-C-02-4175)
(DOE/ET-34209/T1) Avail: NTIS HC A07/MF A01

The fluctuating velocity field, the fluctuating static wall pressure, and the in stream fluctuating static pressure in an annular flow system with a radius ratio of 4.314 were investigated.

Direct measurements were taken of the mean velocoty profile, turbulent velocity field, fluctuating static wall pressure and in stream fluctuating static pressure. Significant results are reported. DOE

N81-11356# Los Alamos Scientific Lab., N. Mex.
FINITE ELEMENT MODELING OF LONG-TERM FLUID-STRUCTURE INTERACTION PROBLEMS IN GEOLOGICAL MEDIA
C. A. Anderson 1980 8 p ref Presented at The Symp. on Computational Methods in Nonlinear Struct. and Solid Mech., Washington, 6-8 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-79-3016; CONF-801003-3) Avail: NTIS HC A02/MF A01

A model is developed to predict long term thermal creep and creep rupture in geological structures under multiaxial stress states and under elevated temperature conditions. An example of the method is given showing the behavior of the crust and mantle while undergoing intrusion by a low density diaper. DOE

N81-11357# California Univ., Livermore. Lawrence Livermore Lab.
DESIGN OF A MAZE STRUCTURE TO ATTENUATE BLAST WAVES
C. M. Bacigalupi 1980 18 p refs
(Contract W-7405-eng-48)
(UCRL-52921) Avail: NTIS HC A02/MF A01

Building criteria for cells used to process and store high explosives dictated maze-type entries, to avoid mechanical closure devices. Experiments were conducted to develop a minimum-cost maze configuration that would limit the effects of an accidental 10-kg detonation to acceptable level (< 15 psig reflected) in adjacent areas. Components of suppressive design that were considered were night-angle turns, blast deflectors, baffles (reduced-area openings) and energy-absorbing materials. The proposed configuration uses multiple baffles and a blast deflector to reduce the exit pressure to about 8 psig reflected. DOE

N81-11358# California Univ., Livermore.
NUMERICAL ANALYSIS OF LAMINAR FORCED CONVECTION IN A SPHERICAL ANNULUS
Dean B. Tuft Jul. 1980 43 p refs Presented at the 4th Biennial Cube Symp., Livermore, Calif., 22-24 Oct. 1980
(Contract W-7405-eng-48)
(UCRL-84655; CONF-801027) Avail: NTIS HC A03/MF A01

Calculations of steady laminar incompressible fluid flow and heat transfer in a spherical annulus are presented. Steady pressure temperatures, velocities, and heat transfer coefficients were calculated for an insulated outer sphere and a 0 C isothermal inner sphere radius was 13.97 cm, the outer sphere radius was 16.83 cm and the radius ratio was 1.2. The transient axisymmetric equations of heat, mass, and momentum conservation were solved numerically in spherical coordinates. The transient solution was carried out in time until steady state was achieved. variable mesh was used to improve resolution near the inner sphere where temperature and velocity gradients were steep. DOE

N81-11359# General Electric Co., Schenectady, N. Y. Power Generation and Propulsion Lab.
TWO-PHASE FLOW AND HEAT TRANSFER IN FLUIDIZED BEDS Final Report, 1 Aug. 1975 - 30 Jun. 1978
F. W. Staub, R. T. Woods, ed., G. S. Canada, and M. H. McLaughlin Jul. 1980 323 p refs
(EPRI Proj. 525-1)
(EPRI-CS-1456) Avail: NTIS HC A14/MF A01

Cold modeling studies of fluidized bed behavior related to coal combustion provide information required for the design and optimization of fluidized bed systems for power generation. Data for flow regime, bed expansion (void fraction), transverse thermal conductivity, and bare- and finned-tube heat transfer were obtained for beds of single and mixed particle sizes fluidized with air and refrigerant at room temperature. Five and ten row tube banks were tested. Generalized predictive models for the bed flow regimes, the bed expansion, the solids circulation rates, and the transfer to tube banks were developed and shown to be qualified by the data for both local and average bed quantities. DOE

N81-11360# General Electric Co., Philadelphia, Pa.
DEVELOPMENT AND DEMONSTRATION OF A STIRLING/RANKINE HEAT ACTIVATED HEAT PUMP Semiannual Report, Jan. - Jun. 1979
R. C. Meier Oct. 1979 134 p refs Prepared in cooperation with American Gas Association, Inc., Arlington, Va.
(Contract EC-77-C-02-2911; GSRI Proj. 5010-341-0052)
(PB80-205388; DOC-80SDS4215; GRI-79/0008; COO-2911-5) Avail: NTIS HC A07/MF A01 CSCL 13A

A residential size, free piston Stirling engine combined with a free piston linear compressor, gas fired heat pump was examined. Performance and operating characteristics of the system and its components were established. The completion of the first prototype was instrumental in determining those design modifications needed to achieve performance goals. A field test prototype was fabricated and a gas utility sponsored test home was selected. GRA

N81-11361# Thermo Electron Corp., Waltham, Mass.
OPEN CYCLE VAPOR COMPRESSION HEAT PUMP Annual Report
Ravi Sakhuja and Frederick E. Becker Jul. 1980 45 p refs
(PB80-205461; GRI-79/0042) Avail: NTIS HC A03/MF A01 CSCL 13A

A compressor test facility was built incorporating a screw compressor modified for steam service. The compressor was tested over a wide range of operating conditions with experimental results showing excellent agreement with predicted performance. The compressor operation with wet steam and water injection was completely satisfactory, demonstrating its suitability for use in a steam heat pump system. GRA

N81-11989*# Atlanta Univ., Ga. Dept. of Mathematics.
AXIALLY SYMMETRIC MOTION OF A ROTATING STRATIFIED FLUID
Benjamin J. Martin *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 17 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20D

N81-11998*# Tennessee Univ. Space Inst., Tullahoma.
STABILITY OF THE STRATIFIELD CYLINDRICAL ANNULUS FLOW
Basil N. Antar *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 13 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20D

N81-12003*# Florida State Univ., Tallahassee.
MEASUREMENT OF VELOCITY FIELDS IN FLUID DYNAMICS EXPERIMENTS
Daniel E. Fitzjarrald *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 6 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20D

N81-12006*# Alabama Univ. in Birmingham.
EXCHANGE OF STABILITY FOR A COLUMN OF FLUID WITH VARIABLE RAYLEIGH NUMBER UNDER FREE BOUNDARY CONDITIONS
Letitia Korbly *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 17 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20D

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N81-11362*# Science Applications, Inc., Tucson, Ariz.
OUTER PLANET INVESTIGATIONS USING A CCD CAMERA

SYSTEM Final Report
Michael J. Price Nov. 1980 26 p refs
(Contract NASW-3332)
(NASA-CR-163704) Avail: NTIS HC A03/MF A01 CSCL 14E

Problems related to analog noise, data transfer from the camera buffer to the storage computer, and loss of sensitivity of a two dimensional charge coupled device imaging system are reported. To calibrate the CCD system, calibrated UBV pinhole scans of the Saturn disk were obtained with a photoelectric area scanning photometer. Atmospheric point spread functions were also obtained. The UBV observations and models of the Saturn atmosphere are analyzed. A.R.H.

N81-11363*# Lunar and Planetary Inst., Houston, Tex.
DETERMINATION OF OPTIMUM VOLTAGES OF ION FOCUSING DEVICES USING COMPUTER TECHNIQUES
Barbara A. Eckstein 1980 40 p refs Sponsored in part by NASA
(NASA-CR-163730) Avail: NTIS HC A03/MF A01 CSCL 14B

Electric potentials for two dimensional cross sections of ion focusing devices used in a mass spectrometer are calculated via a series of computer programs designed to compute potentials between areas of fixed voltages. Ion trajectories within these devices may be determined by computer and a histogram obtained which plots ion density against ion position along a plate of the focusing device. For each lens system, a plate voltage may be changed, the electric potentials recalculated, and a new histogram calculated in order to determine if the new voltage configuration has increased the device's efficiency. This process may be repeated until the optimum voltage values have been found for maximum particle transmission in each focusing device. Author

N81-11364# Aeronautical Research Labs., Melbourne (Australia).
A SIX-CHANNEL QUICK-LOOK UNIT FOR THE AODYNAMICS DIVISION MKI AIRBORNE DATA ACQUISITION PACKAGE
A. J. Farrell, S. H. Creed, I. M. Kerton, and P. Ferrarotto Feb. 1980 31 p refs
(AD-A089975; ARL/AERO-TM-319) Avail: NTIS HC A03/MF A01 CSCL 09/5

A ground-based unit is described which, when connected to a chart recorder, provides a post-flight analogue record of up to six channels simultaneously of data recorded on the Aerodynamics Division MKI Airborne Data Acquisition Package. GRA

N81-11365# Aeronautical Research Labs., Melbourne (Australia).
TRANSDUCER INSTALLATION FOR THE SEA KING MK 50 MATHEMATICAL MODEL VALIDATION FLIGHT TESTS
D. T. Hourigan Mar. 1980 24 p refs
(AD-A089924; ARL/AERO-TM-322; AR-001-806) Avail: NTIS HC A02/MF A01 CSCL 01/3

The installation of transducers in a R.A.N. Sea King MK 50 helicopter is described. These transducers were used to obtain flight trials data for validating a mathematical model of the aircraft. GRA

N81-11366# Maryland Univ., College Park. Computer Vision Lab.
EXTRACTING LINEAR FEATURES FROM IMAGES USING PYRAMIDS
Michael Shneier Jan. 1980 21 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090238; TR-855) Avail: NTIS HC A02/MF A01 CSCL 09/2

A method is described of extracting linear features from images. The approach is to construct a series of lower-resolution versions of the original image (a pyramid), and to look for lines in these images. A line in a low-resolution image corresponds to a thicker linear feature in a high-resolution image. The position and extent of this linear feature is calculated from the low-resolution image, and a threshold is found which, when applied in the neighborhood of the feature in the high-resolution image, segments the linear feature from its background. Advantages of the method are that only the parts of the image in the neighborhood of linear features need be thresholded, and that different thresholds may be used to extract the various linear features in the image. GRA

N81-11367# Rochester Univ., N. Y. Coll. of Engineering and Applied Science.
INVESTIGATIONS OF PHOTOGRAPHIC GRAIN IN COHERENT AND INCOHERENT SYSTEMS Final Report, 11 Oct. 1976 - 30 Jun. 1980
Brian J. Thompson 8 Sep. 1980 7 p refs
(Grant DAAG29-77-G-0014)
(AD-A089955; ARO-14101.3-GS) Avail: NTIS HC A02/MF A01 CSCL 14/5

The initial set of problems studied in this work consisted of: (1) the comparison of the behaviour of photographic grain in coherent versus incoherent optical systems; (2) a more complete understanding of the signal dependence of grain in coherent and incoherent systems; and (3) the implications of the results of (1) and (2) in the fields of image evaluation and image processing. GRA

N81-11368# Systems Science and Software, La Jolla, Calif.
DEVELOPMENT OF AIRBLAST AND SOIL STRENGTH INSTRUMENTATION Final Report, 1 May 1978 - 1 Jan. 1980
P. L. Coleman and M. A. Groethe 1 Feb. 1980 121 p refs
(Contract DNA001-78-C-0244)
(AD-A090123; SSS-R-80-4367; DNA-5225F) Avail: NTIS HC A06/MF A01 CSCL 14/2

The development and testing of airblast and soil strength gauges are presented. The airblast sensors include an accelerometer instrumented drag sphere to measure dynamic pressure and bar gauge probes to measure static, stagnation and reflected pressures at levels to 10 to the 8th power Pa (1 kilobar). The soil strength gauge is a shock hardened dynamic cone penetrator. An analysis of a slug type heat flux sensor is given. GRA

N81-11369# Exxon Nuclear Co., Inc., Richland, Wash.
INTERNAL ATTACHMENT OF LASER BEAM WELDED STAINLESS STEEL SHEATHED THERMOCOUPLES INTO STAINLESS STEEL UPPER END CAPS IN NUCLEAR FUEL RODS FOR THE LOFT REACTOR
Richard K. Welty and Raymond D. Reid 1980 8 p refs Presented at the Intern. Symp. of the Soc. of Photo-Optical Instrumentation Engs., San Diego, Calif., 28 Jul. 1980
(Contract DE-AC07-76ID-01570)
(CONF-800719-5) Avail: NTIS HC A02/MF A01

The feasibility of laser welding a single 0.063 inch diameter stainless steel (304) sheathed thermocouple into a stainless steel (316) upper end cap for nuclear fuel rods was determined. A laser beam was selected because of the extremely high energy input in unit volume that can be achieved allowing local fusion of a small area irrespective of the difference in material thickness to be joined. A special weld fixture was designed and fabricated to hold the end cap and the thermocouple with angular and rotational adjustment under the laser beam. A commercial pulsed laser and energy control system was used to make the welds. DOE

N81-11370# Stanford Linear Accelerator Center, Calif. Positron-Electron Project.
REVIEW OF ACCELERATOR INSTRUMENTATION
J. L. Pellegrin May 1980 12 p refs Presented at the 11th Intern. Conf. on High Energy Accelerators, Geneva, 7-11 Jul. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-PUB-2522; CONF-800740-11) Avail: NTIS HC A02/MF A01

Some of the problems associated with the monitoring of accelerator beams, particularly storage rings' beams, are reviewed along with their most common solutions. The various electrode structures used for the measurement of beam current, beam position, and the detection of the bunches' transverse oscillations, yield pulses with subnanosecond widths. The electronics for the processing of these short pulses involves wide band techniques and circuits usually not readily available from industry or the integrated circuit market: passive or active, successive integrations,

linear gating, sample and hold circuits with nanosecond acquisition time, etc. The monitoring of the ultrashort beams of colliding linear accelerators or single pass colliders is also discussed. To minimize the beam emittance, the beam position must be measured with a high resolution, and digitized on a pulse to pulse basis. Experimental results obtained with the Stanford two mile Linac single bunches are included. DOE

N81-11371# California Univ., Berkeley. Lawrence Berkeley Lab. Physics, Computer Science, and Mathematics Div.
ADVANCES IN DIAGNOSTIC INSTRUMENTATION
Victor Perez-Mendez Jan. 1980 32 p refs Presented at the Intern. School of Radiation Damage and Protect., Ettore Majorana Center for Scientific Culture, Erice, Sicily, 16-26 Sep. 1979
(Contract W-7405-eng-48)
(LBL-9892) Avail: NTIS HC A03/MF A01

Developments in medical imaging in the last ten years are described. Techniques include fine focus X-ray tubes, computerized tomography, emission tomography, and ultrasonography. DOE

36 LASERS AND MASERS

Includes parametric amplifiers.

N81-11372# Toronto Univ. (Ontario).
LASER ABLATION AND SELECTIVE EXCITATION DIRECTED TO TRACE ELEMENT ANALYSIS Ph.D. Thesis
V. H. S. Kwong Aug. 1980 96 p refs
(Grant AF-AFOSR-2902-76)
(UTIAS-234; ISSN-0082-5255) Avail: NTIS HC A05/MF A01

A trace (element) analyser based on laser ablation and selectively excited radiation is proposed as an ultramicro-ultratrace technique for quantitative element analysis. Measurements of trace quantities of chromium in samples of NBS standard reference material (steel), doped skim milk powder and doped flour were undertaken. There is a linear 45 deg slope for Log/Log plot dependence of signal versus concentration that extends at least up to 1.3% (concentration by weight) in the case of chromium. The detection limit for the current unoptimized system is in the ppm range which corresponds to the absolute detection limit of 10 to the 13th power g. Although no chemical interference effects were observed, two physical interference effects were evident: differential mass vaporization and inhomogeneous spatial and temporal distribution of fast expanding analyte. The differential Doppler shift between the atoms along the line of observation reduces self-absorption even at high analyte concentrations. A.R.H.

N81-11373# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.
TUNABLE LASER EXCITATION PROFILE OF SURFACE ENHANCED RAMAN SCATTERING FROM PYRIDINE ADSORBED ON A COPPER ELECTRODE SURFACE
Craig S. Allen, George C. Schatz, and Richard P. VanDuyne 15 Sep. 1980 16 p refs Revised Submitted for publication
(Contract N00014-76-C-0794; Grant NSF CHE-78-24866)
(AD-A089157; TR-2-Rev) Avail: NTIS HC A02/MF A01 CSCL 20/5

The wavelength dependence of Surface Enhanced Raman Scattering from pyridine on a copper electrode has been measured and found to correlate closely with the optical properties of copper metal. The results are interpreted in the light of the image field model of the SERS mechanism. Data are presented which indicate that the observed time decay of the 1037 /cm mode in the Ag case and the weakness of the 1037 /cm mode on Cu may have a common origin. GRA

N81-11374# JAYCOR, Alexandria, Va.
EXACT: LOW GAIN FORMULATION OF THE FREE ELECTRON LASER-INCLUDING TRANSVERSE VELOCITY SPREAD AND WIGGLER INCOHERENCE
A. Gover and P. Sprangle 15 Sep. 1980 26 p refs
(Contract N00173-80-C-0253; DARPA Order 3817)
(AD-A089765; NRL-MR-4221) Avail: NTIS HC A03/MF A01 CSCL 20/5

It is shown that in the small signal-low gain regime, an analytic expression for the gain can be derived, which is correct for general electron distribution function and general longitudinal variation of the transverse magnetic field pump. This expression is used to evaluate the effects on the gain curve due to transverse momentum spread in the beam as well as the inaccuracies (incoherence) in the magnetic pump phase and amplitude. The restricting criteria for the neglect of these effects are derived. GRA

N81-11375# General Research Corp., Huntsville, Ala.
FIRE CONTROL SIMULATOR REQUIREMENTS, VOLUME 3 Final Report, Jan. - Dec. 1979
R. R. Parker, W. V. Bouldin, C. P. Marks, and G. K. Warmbrod May 1980 90 p refs
(Contract DAAK40-78-C-0054)
(AD-A090040; GRC-CR-6-824-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 19/5

A set of requirements for a HEL weapon fire control system simulation were generated in this study. A functional approach, taking advantage of the decoupling of implementation decisions from values of performance parameters, is recommended. A functional breakdown of the HELWS appears in the report, described in terms of inputs, sequencing, processing, and output of each function and subfunction. A demonstration version of the simulator has been implemented on the CDC 7600 at the ARC, using that facility's graphics capabilities as a primary input output device. A description of the capabilities of the simulation executive is given, and a test case example, along with input data and listings. Schedules for the simulation development are given and task descriptions appear as the last section of the report. GRA

N81-11376# PCR, Inc., Gainesville, Fla.
SYNTHESIS SUPPORT FOR THE DEVELOPMENT OF A SATURABLE ABSORBER OPERATING AT TWO MICRONS Final Report, 29 Sep. 1978 - 29 Feb. 1980
Keith B. Baucom and Calvin D. Padgett Aug. 1980 38 p refs
(Contract DAAG29-78-C-0045)
(AD-A089998; ARO-16338.1-A-P) Avail: NTIS HC A03/MF A01 CSCL 07/3

Dithiene complexes are promising candidates for dye 'Q' switches functioning as saturable absorbers operating at two microns. Although these compounds are not commercially available, similar compounds have been prepared. The purpose of this contract was to investigate the synthesis of several dithienes of interest to the Army. The number of dithienes (16), the complexity of the syntheses required to obtain them and the limited funding available was such that the scope of the program was narrowed by the project monitor setting priorities with regard to which dithiene should be selected for synthesis. 6,7-Dithioquinoxaline was given first priority. GRA

N81-11377# Stanford Univ., Calif. Edward R. Ginzton Lab. of Physics.
REMOTE ATMOSPHERIC MEASUREMENTS OF CH-4 USING A LiNbO3 TUNABLE SOURCE Final Report, Oct. 1978 - Jun. 1979
Robert L. Byer and Martin Endemann Tyndall AFB, Fla. AF Engineering and Services Lab. Mar. 1980 27 p refs
(Grant EPA-R-805750-01; AF Proj. 1900)
(AD-A089993; AFESC/ESL-TR-80-11) Avail: NTIS HC A03/MF A01 CSCL 20/5

A laser transmitter tuned by means of a lithium niobate optical parametric oscillator was employed to demonstrate the capability for remote measurement of gaseous pollutants in the atmosphere. Measurements of methane were obtained continuously over an 18-hour period with a precision of better than 0.06 parts per million. The long path measurements of methane were in excellent agreement with a Bay Area Pollution Control District point monitoring station. Capabilities of the tunable laser transmitter to measure other molecules, as well as atmospheric temperature, are discussed. GRA

N81-11378# Science Applications, Inc., Boulder, Colo. Plasma Research Inst.
THEORY OF FREE ELECTRON LASER INSTABILITY IN A

RELATIVISTIC ANNULAR ELECTRON BEAM
Han S. Uhm and Ronald C. Davidson Aug. 1980 50 p refs Prepared in cooperation with MIT, Cambridge, Mass.
(Contract N00014-79-C-0555)
(AD-A089769; SAI-254-80-494-LJ; PRI-13) Avail: NTIS HC A03/MF A01 CSCL 20/5

A self-consistent theory of the free electron laser instability is developed for a hollow electron beam propagating through an undulator (multiple mirror) magnetic field. The stability analysis is carried out within the framework of the linearized Vlasov-Maxwell equations. The dispersion relation describing the free electron laser instability in a hollow relativistic electron beam is obtained for an equilibrium distribution function in which all electrons have same value of transverse energy and the same value of canonical angular momentum, and a Lorentian distribution in axial momentum. It is shown that the influence of finite radial geometry plays a critical role in determining detailed stability behavior. Moreover, the growth rate and bandwidth of the instability can be expressed in terms of Budker's parameter upsilon, instead of the plasma frequency as in the case of a uniform density beam. Furthermore, it is found that free electron laser stability properties exhibit a sensitive dependence on axial momentum spread. GRA

N81-11379# Science Applications, Inc., Boulder, Colo. Plasma Research Inst.
SELF-CONSISTENT VLASOV DESCRIPTION OF THE FREE ELECTRON LASER INSTABILITY
Ronald C. Davidson (MIT, Cambridge) and Han S. Uhm (Naval Surface Weapons Center, Silver Spring, Md.) Jan. 1980 41 p refs
(Contract N00014-79-C-0555)
(AD-A089833; SAI-254-80-475-LJ; PRI-9) Avail: NTIS HC A03/MF A01 CSCL 20/5

In recent years there have been several theoretical and experimental investigations of the free electron laser which generates coherent electromagnetic radiation using an intense relativistic electron beam as an energy source. With few exceptions, theoretical studies of the free electron laser instability are based on highly simplified models which often neglect beam kinetic effects and coupling to higher harmonics of the fundamental wiggler wavenumber k sub 0, or make use of very idealized approximations in analyzing the matrix dispersion relation. The purpose of the present paper is to develop a fully self-consistent description of the free electron laser instability base d on the Vlasov-Maxwell equations. The final matrix dispersion relation includes all beam kinetic effects and coupling to arbitrary harmonic number (n) of the fundamental wiggler wavenumber k sub 0. Moreover, the final matrix dispersion relation makes no a priori assumption that any off-diagonal elements are negligibly small. The present analysis assumes a relativistic electron beam with uniform cross-section propagating in the z-direction through a helical wiggler field. GRA

N81-11380# Science Applications, Inc., Boulder, Colo. Plasma Research Lab.
HELICALLY DISTORTED RELATIVISTIC ELECTRON BEAM EQUILIBRIA FOR FREE ELECTRON LASER APPLICATIONS
Ronald C. Davidson and Han S. Uhm Jul. 1980 40 p refs Prepared in cooperation with MIT, Cambridge
(Contract N00014-79-C-0555)
(AD-A089786; SAI-254-80-476-LJ; PRI-10) Avail: NTIS HC A03/MF A01 CSCL 20/9

The purpose of this paper is to develop a self-consistent kinetic description of helically distorted relativistic electron beam equilibria for free electron laser applications. In particular, radially confined equilibria are considered for a helically distorted electron beam propagating in the combined transverse wiggler and uniform axial guide fields. GRA

N81-11381# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.
SIMULATED RAMAN LASER EXCITATION OF SPONTANEOUS RESONANCE RAMAN SCATTERING
Keith D. Parks and Richard P. VanDuyne Sep. 1980 15 p refs Submitted for publication
(Contract N00014-79-C-0794; Grant NSF CHE-78-00877)
(AD-A090041; TR-3) Avail: NTIS HC A02/MF A01 CSCL 20/5

The efficient conversion of the second and third harmonics of a Nd:YAG laser to near UV radiation in the 395-500 nm range by stimulated Stokes (and anti-Stokes) Raman scattering (SRS) in a 1.0 meter Raman oscillator containing compressed H2 or D2 gas has been used as an excitation source for spontaneous resonance Raman spectroscopy (RRS). SRS excited RR spectra are shown for the anion radical of the strong electron acceptor species tetracyanoquinodimethane (TCNQ). GRA

N81-11382# University Coll., Cork (Ireland). Dept. of Electrical Engineering.
GENERATION AND DETECTION OF SUBMILLIMETRE (FIR) RADIATION USING OPTICAL PUMPING IN A GAS LASER SYSTEM Final Scientific Report, 1 Jun. 1976 - 30 Sep. 1979
M. C. Sexton 30 Nov. 1979 11 p refs Prepared for European Office of Aerospace Research and Development, London
(Grant AF-AFOSR-3077-76)
(AD-A089944; AFOSR-80-0880TR) Avail: NTIS HC A02/MF A01 CSCL 20/5

The development of a CO2 waveguide laser as a pump source for a CW far-infrared D2O laser is described. Performance with regard to output power and tunability is reported with special reference to the application of these lasers in overcoming the mismatch which can exist between the pump laser frequency and the vibrational absorption of the pumped molecule. This report presents summaries of the construction and performance of such lasers as well as photoconductive detectors and points the direction towards the achievement of a tunable source of pump radiation for a D2O laser. Absorption measurements in D2O using the waveguide laser are also presented. Lasing action in straight H2O and D2O lasers is also summarised over the 20 - 120 micron wavelength range. GRA

N81-11383# Defense Intelligence Agency, Washington, D.C. Directorate for Scientific and Technical Intelligence.
BIBLIOGRAPHY OF SOVIET LASER DEVELOPMENTS, NUMBER 44, NOVEMBER - DECEMBER 1979
13 Aug. 1980 59 p
(AD-A090190; DIA-DST-2700Z-005-80) Avail: NTIS HC A04/MF A01 CSCL 20/5

This is the Soviet Laser Bibliography for November-December 1979, and is No. 44 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics. GRA

N81-11384# Defence Research Establishment Valcartier (Quebec).
A ONE-DIMENSIONAL NUMERICAL MODEL OF LASER HEATING OF TARGET SLABS
J. P. Morency May 1980 53 p refs
(AD-A089906; DREV-R-4166/80) Avail: NTIS HC A04/MF A01 CSCL 20/5

This report establishes a numerical scheme to solve the nonlinear one-dimensional heat transfer equation. The scheme is then applied to the case of laser-metals interaction and used to show the importance of thermophysical properties variation on the temperature distribution within a slab. GRA

N81-11385# Honeywell Corporate Material Sciences Center, Bloomington, Minn.
DEVELOPMENT OF FLUORIDES FOR HIGH POWER LASER OPTICS Final Report, 1 Apr. 1978 - 31 Mar. 1980
J. F. Ready and H. Vora Jul. 1980 54 p refs
(Contract DE-AC08-78DP-40020)
(NVO-1555-5) Avail: NTIS HC A04/MF A01

The optical properties of both single-crystal and press-forged LiF are evaluated including optical homogeneity at 633 nm, stress

birefringence, scattering at 633 nm, residual absorption over the spectral range 339 to 3800 nm, and laser damage thresholds for 1 ns, 1064 nm and 700 ps, 266 nm laser pulses. The results of the optical characterization tasks indicate that LiF single crystals can be press-forged without seriously degrading their optical properties. The following mechanical properties of both single-crystal and press-forged LiF are evaluated: yield strength in compression, proportional limit and fracture strength in 3 and 4 point bending, fracture energy, and threshold for microyield. The results indicate that the mechanical properties of LiF single crystals can be improved significantly by press forging. DOE

N81-11386# Los Angeles-Orange County Metropolitan Area Project, Whittier, Calif.
FREE ELECTRON LASERS
Charles A. Brau 1980 31 p refs Presented at the Intern. Conf. on Lasers, Shanghai, 5-8 May and Peking, 19-22 May 1980 Sponsored in part by AFOSR, DARPA, and NASC
(Contract W-7405-eng-36)
(LA-UR-80-2015; CONF-800555-2) Avail: NTIS HC A03/MF A01

A review of experimental and theoretical concepts of a free electron laser is given. The possibilities of scaling these lasers to high powers are discussed. DOE

N81-11387# Oak Ridge Y-12 Plant, Tenn. Nuclear Div.
LASER SURFACE FINISH GAUGE
Harry S. Corey 12 May 1980 9 p Presented at the Intern. Symp. of the Soc. of Photo-Optical Instrumentation Engrs., San Diego, Calif., 28 Jul. - 1 Aug. 1980
(Contract W-7405-eng-26)
(Y/DX-139; CONF-800719-3) Avail: NTIS HC A02/MF A01

A laser surface finish guage was developed to measure the roughness of the entire inside surface of hemishells in the range of 4 to 10 microinches roughness average (Ra). Standards were fabricated that allow for traceability of the gauge's measurements to the National Bureau of Standards. The gauge employs the principles of angular scatter from a laser beam and was designed to eliminate errors introduced by varying degrees of part reflectance and changes in laser intensities. A microprocessor is used to extract data from the standards and manipulate the scatter information from test parts to produce a continuous trace of the part surface roughness on a strip chart. The gauge is installed in a product certification laboratory and a statistical evaluation made which indicates a repeatability of +-0.5 microinch Ra. DOE

N81-11388# California Univ., Livermore. Lawrence Livermore Lab.
METAL ORGANIC-CHEMICAL VAPOR DEPOSITION FABRICATION OF SEMICONDUCTOR LASERS
Christopher Thomas 6 Aug. 1980 11 p refs Presented at the 52d NTA Ann. Conv., Chicago, 12-16 Aug. 1980
(Contract W-7405-eng-48)
(UCRL-84763; CONF-800836-1) Avail: NTIS HC A02/MF A01

The metal organic chemical vapor deposition (MO-CVD) process was studied and implemented in detal. Single crystal GaAs, and Ga(x)Al(1-x)As films were grown on GaAs by depositing metal organic alkyl gallium compounds in the presence of an arsine mixture. The metal organic chemical vapor deposition process allowed formation of the semiconductor compound directly on the heated substrate in only one hot temperature zone. With MO-CVD, semiconductor films can be efficiently produced by a more economical, less complicated process which will lend itself more easily than past fabrication procedures, to high quantity, high quality reproduction techniques of semiconductor lasers. Clearly MO-CVD is of interest to the communication industry where semiconductor lasers are used extensively in fiber optic communication systems, and similarly to the solar energy business where GaAs substrates are used as photoelectric cells. DOE

N81-11389# Los Alamos Scientific Lab., N. Mex.
ALIGNMENT AND FOCUSING DEVICE FOR A MULTIBEAM LASER SYSTEM
William C. Sweatt 1980 5 p refs Presented at the Intern. Symp. of the Soc. of Photo-Optical Instrumentation Engrs., San Diego, Calif., 28 Jul. - 1 Aug. 1980
(Contract W-7405-eng-36)
(LA-UR-80-1885; CONF-800719-10) Avail: NTIS HC A02/MF A01

The Antares system is a 24 beam CO2 pulse laser. To assess the quality of a given beam, a Smartt (point diffraction) interferometer was at the desired focal point and illuminated with an alignment laser. The resulting fringe pattern shows defocus, lateral misalignment, and beam aberrations; all of which can be minimized by tilting and translating the focusing mirror and preceding flat mirror. The device described will remotely translate the Smartt interferometer to any position in the target space and point it in any direction using a two axis gimbal.DOE

N81-11390# Los Alamos Scientific Lab., N. Mex.
ONE-DIMENSIONAL COMPUTER SIMULATIONS OF EXPLODING PUSHER TARGETS FOR THE LOS ALAMOS HELIOS LASER SYSTEM
William P. Gula Aug. 1980 14 p refs
(Contract W-7405-eng-36)
(LA-8458-MS) Avail: NTIS HC A02/MF A01

Simulations of 10.6 micron m laser pulses with peak powers in the 5 to 20 TW range on exploding pusher targets are summarized. These calculations were done in order to predict and understand the first experimental results on the Helios CO2 eight beam laser system. DOE

N81-11391# California Univ., Livermore. Lawrence Livermore Lab. Advanced Laser Group.
HIGH-POWER PULSED LASERS
John F. Holzrichter Apr. 1980 88 p refs
(Contract W-7405-eng-48)
(UCRL-52868) Avail: NTIS HC A05/MF A01

The development of large multibeam fusion lasers is discussed in detail. Basic concepts of the laser plasma system, a discussion of lasers that are useful for short pulse, high power operation, laser design constraints, optical diagnostics, and system organization are included. DOE

N81-11392# Brookhaven National Lab., Upton, N. Y.
LASER DRIVEN GRATING LINAC
R. B. Palmer 1980 15 p refs Presented at 11th Intern. Conf. on High Energy Accelerators, Geneva, 7 Jul. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28131; CONF-800740-12) Avail: NTIS HC A02/MF A01

The fields induced over a grating exposed to plane parallel light were explored. Acceleration is possible if either the particles travel skew to the grating lines, or if the radiation is falling at a skew angle onto the grating. A general theory of diffraction in this skew case is given. In one particular case numerical solutions were worked out for some deep grating. Accelerating fields larger even than the initial fields were obtained, the limit being set by resistive losses on the grating surface. Simple calculations were made to see what accelerating fields might be obtained using CO2 lasers. Accelerations of 2 to 20 GeV per meter seem possible depending on whether the grating is allowed to be destroyed or not. Power requirements, injection and focussing are briefly discussed and no obvious difficulties were seen. The proposed mechanism should be considered as a good candidate for the next generation of particle accelerators. DOE

N81-12000*# Arkansas Univ. at Little Rock.
MEASUREMENTS OF THE SAMPLING VOLUME OF AN INFRARED LASER DOPPLER VELOCIMETER FOR THE STUDY OF FEASIBILITY OF SIMULTANEOUS THREE-DIMENSIONAL VELOCITY PROFILE MAPPING
Robert L. Bond *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 26 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N81-11393 Stanford Univ., Calif.
OPTIMAL CLOSED-LOOP CONTROL OF AN INTERNAL

COMBUSTION ENGINE Ph.D. Thesis
Itshak Glaser 1980 248 p
Avail: Univ. Microfilms Order No. 8024662

A closed loop scheme was designed which maintains a spark ignited engine operating at minimum fuel consumption for a given emissions level regardless of any external disturbances or mechanical degradation. It was found that for a given speed and load, this optimal condition can be closely achieved by holding the angle of the cylinder peak pressure constant. The optimum angle is also a function of engine power with open loop control. Any deterioration or external disturbance will change this angle. But a closed loop system can be made to restore this angle to its optimum value by properly controlling spark timing. An inexpensive piezoelectric sensor installed between the engine head and the spark plugs is used as the feedback element. As an example of system effectiveness, the open loop controlled engine yielded 4% increase in fuel consumption while relative humidity was increased to 75% in 90F whereas the closed loop system demonstrated only 2% deterioration. Dissert. Abstr.

N81-11394*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANISOTROPIC TRIBOLOGICAL PROPERTIES OF SILICON CARBIDE
Kazuhisa Miyoshi and Donald H. Buckley 1980 20 p refs Proposed for presentation at the Intern. Conf. on Wear of Materials, San Francisco, 30 Mar. - 1 Apr. 1980
(NASA-TM-81547; E-505) Avail: NTIS HC A02/MF A01 CSCL 11D

The anisotropic friction, deformation and fracture behavior of single crystal silicon carbide surfaces were investigated in two categories. The categories were called adhesive and abrasive wear processes, respectively. In the adhesive wear process, the adhesion, friction and wear of silicon carbide were markedly dependent on crystallographic orientation. The force to reestablish the shearing fracture of adhesive bond at the interface between silicon carbide and metal was the lowest in the preferred orientation of silicon carbide slip system. The fracturing of silicon carbide occurred near the adhesive bond to metal and it was due to primary cleavages of both prismatic (10(-1)0) and basal (0001) planes. R.C.T.

N81-11395*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF TANGENTIAL TRACTION AND ROUGHNESS ON CRACK INITIATION/PROPAGATION DURING ROLLING CONTACT
Norimune Soda (Tokyo Univ. Japan) and Takashi Yamamoto (Tokyo Univ. of Agriculture and Technology, Japan) 1980 37 p refs Proposed for presentation at the 36th Ann. Meeting of ASLE, Pittsburgh, 11-14 May 1981
(NASA-TM-81608; E-604) Avail: NTIS HC A03/MF A01 CSCL 20K

Rolling fatigue tests of 0.45 percent carbon steel rollers were carried out using a four roller type rolling contact fatigue tester. Tangential traction and surface roughness of the harder mating rollers were varied and their effect was studied. The results indicate that the fatigue life decreases when fraction is applied in the same direction as that of rolling. When the direction of fraction is reversed, the life increases over that obtained with zero traction. The roughness of harder mating roller also has a marked influence on life. The smoother the mating roller, the longer the life. Microscopic observation of specimens revealed that the initiation of cracks during the early stages of life is more strongly influenced by the surface roughness, while the propagation of these cracks in the latter stages is affected mainly by the tangential traction. Author

N81-11396# CR Industries, Elk Grove Village, Ill. Mechanical Products Div.
SERVICE LIFE DETERMINATION FOR THE UH-60A (BLACKHAWK) HELICOPTER ELASTOMETRIC BEARINGS Final Report
Seymour A. Hatch Apr. 1980 249 p refs
(Contract DAAG46-78-C-0029)
(AD-A089416; USAAVRADCOM-TR-80-F-8; AMMRC-TR-80-24) Avail: NTIS HC A11/MF A01 CSCL 13/8

The contract with AMMRC calls for developing an improved method of predicting the service life of elastomeric bearings in general with specific reference to the Blackhawk main rotor bearings. One object of this study is to develop a correlation between a bearing that has sustained some endurance damage and its remaining service life based on its appearance. The second objective is to develop an analytical capability to predict the service life of bearings without the necessity for testing. An endurance rating for an appropriate elastomer is determined by testing a series of 13 test specimens. The test specimen and the Blackhawk main rotor bearings are analysed by finite element methods. A procedure is developed for relating the complex strain history of the Blackhawk bearings to the endurance data so that a life prediction can be made for the main rotor bearings without testing. The main rotor bearings are then tested and experimental and analytical results compared. GRA

N81-11397# General Electric Co., St. Petersburg, Fla. Metallurgy and Ceramics Lab.
EFFECT OF SURFACE TREATMENT ON STRENGTH OF MOLYBDENUM/GLASS-CERAMIC SEAL IN A VACUUM TUBE
R. K. Spears 25 Aug. 1980 60 p refs
(Contract DE-AC04-76DP-00656)
(GEPP-TIS-510) Avail: NTIS HC A04/MF A01

Axial compression and ultrasonic defects tests were used to determine the benefits of etching molybdenum frames prior to sealing a glass ceramic insulator to the frames. Concentrated acid, diluted acid, chromic-acid, and chromic-acid dipped followed by nickel plating (the control sample) were the etchants used. No significant difference was found between the three parameters and the control. The day to day variation in compression strength and ultrasonic defects of these test frames was also studied. Except for the fact that there were substantially more ultrasonic defects on the first day, there appeared to be no other indications that the day the parts were sealed was a significant factor. The effect of position in the sealing furnace was also examined. Generally, there were more ultrasonic defects and a lower axial compression test load for the parts sealed in the lower portions of the two 5-part stacks than near the top of each stack. There was no substantial difference between axial compression test results between the top and bottom stacks. DOE

N81-11398# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ASSESSMENTS OF EXTERNAL COMBUSTION BRAYTON-CYCLE ENGINE POTENTIAL IN TOTAL AND INTEGRATED ENERGY SYSTEMS
T. J. Marciniak, J. C. Bratis, A. Davis, M. L. Jain, T. L. Ashe (AiReseach Manufacturing Co., Phoenix, Ariz.), L. D. Six (AiResearch Manufacturing Co., Phoenix, Ariz.), and S. W. Trimble (AiResearch Manufacturing Co., Phoenix, Ariz.) Mar. 1980 112 p refs
(Contract W-31-109-eng-38)
(ANL/ES-96) Avail: NTIS HC A06/MF A01

The history, advantages, disadvantages, and performance and cost characteristics of the external combustion, Brayton engine are discussed. A development program that would lead to a commercializable external combustion, Brayton engine using an atmospheric fluidized bed combustor is described. The fluidized bed offers a method for burning coal in an environmentally acceptable manner at a fairly reasonable cost so that the external combustion Brayton concept can be used in the residential/commercial sector. Based on this study, it appears that the external combustion, Brayton engine, using a fluidized-bed combustion system, offers a technologically sound alternative for developing an economically viable, environmentally acceptable method for using non-scarce fuels. Although the efficiency of the engine is not as high as that projected for large diesel and Stirling engines, the capital cost advantages, fuel flexibility, relatively low developmental costs, and high chance of success make it an attractive alternative. DOE

N81-11399# Thermo Electron Corp., Waltham, Mass.
STATUS REPORT ON DIESEL ORGANIC-RANKINE

COMPOUND ENGINE FOR LONG-HAUL TRUCKS
Oct. 1979 35 p Presented at the DOE Automotive Technol. Develop. Contractors Coord. Meeting, Dearborn, Mich., 23 Oct. 1979
(Contract DE-AC02-76CS-52832; EY-76-C-02-2832)
(TE-4257-72-80; CONF-791082-2) Avail: NTIS HC A03/MF A01

Completely integrated compound engine, consisting of a diesel engine coupled to a Rankine engine, which operates on the exhaust heat from the diesel engine was developed and demonstrated. The prototype compound engine is built around a standard Mack Truck diesel engine, and the waste heat recovery system is a thermo electron organic Rankine bottoming cycle system incorporating a turbine expander delivering power to the diesel engine drive train. The use of the diesel organic Rankine compound engine is in large, heavy duty trucks for long distance hauling. Here the engine load and speed requirements are nearly constant over a large portion of the operating hours, and high mileages are accumulated. Thus, the potential fuel savings is sufficient to justify the added cost of a bottoming cycle system. Based on engine dynamometer tests to date, the addition of an organic Rankine bottoming cycle to a long haul diesel truck can improve the fuel economy by 15 percent over a typical duty cycle. R.K.G.

N81-11400# Johns Hopkins Univ., Laurel, Md.
FLYWHEEL SEAL TEST PROGRAM
C. M. Blackburn May 1980 30 p
(Contract DE-AC04-76DP-00789)
(SAND-80-7019) Avail: NTIS HC A03/MF A01

The test program included a large number of meticulous disassembly and mechanical adjustment operations aimed at isolating the cause of inconsistent torque data. Although some acceptable torque measurements were eventually obtained, there was occasional evidence of mechanical interference between the stationary and rotating seal components. Neither of the seals tested was capable of sealing one atmosphere against the design pressure of 0.001 to 0.001 Torr, possibly because of internal interference problems. One seal and its test fixture were returned to the manufacturer for post testing examination. The manufacturer concluded that due to the high sensitivity of this unit to alignment, the first prototype hardware supplied to APL will not produce favorable results, even with further modifications. It is believed that the difficulties encountered with these seals were largely the result of the tight axial tolerances, and do not necessarily indicate any basic problem with the seal concept. DOE

N81-11401# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ULTRASONIC PROPERTIES OF AUSTENITIC STAINLESS STEEL WELDS
L. A. Lott May 1980 35 p refs
(Contract DE-AC07-76ID-01570)
(EGG-FM-5160) Avail: NTIS HC A03/MF A01

Measurements of ultrasonic velocity and attenuation were made on welded austenitic stainless steel specimens, and data correlated to flaw detectability. Measurements were made at 2.25 MHz for both longitudinal and shear waves as functions of propagation and polarization directions. In stainless steel welds, a high degree of anisotropy exists with respect to ultrasonic wave propagation. Measurements of reflected signals from simulated defects in a welded stainless steel plate indicate that, for 45 degree angle beams, longitudinal waves exhibit larger signal-to-noise ratios than shear waves. Horizontally polarized shear waves exhibit larger signal-to-noise ratios than shear waves and vertically polarized shear waves at 45 degrees. These results have potential significance for practical ultrasonic examination of welded stainless steel structures. DOE

N81-11402# Sandia Labs., Albuquerque, N. Mex.
PROCESS FOR INCREASING THE REACTION RATE IN ALUMINOTHERMIC REACTIONS, PARTICULARLY IN THEIR WELDING APPLICATIONS
A. G. Goldschmidt 21 Jun. 1980 6 p Transl. into ENGLISH from French Patent no. 705569, 21 Jun. 1980 6 p
(SAND-80-6011) Avail: NTIS HC A02/MF A01

A process for increasing the reaction rate in aluminothermic operations, in particular applied to welding is described. The process is characterized by the fact that an alloy aluminum and small quantities of metals or metalloids are prepared which have an affinity for oxygen that is greater than that of aluminum, such as calcium, magnesium, sodium, etc. These metals were added to the aluminum individually or in groups of several metals combined, in quantities of a few percent. DOE

N81-11994*# Military Academy, West Point, N. Y. Dept. of Mechanics.
FLUID DYNAMIC ANALYSIS OF THE SPACE SHUTTLE MAIN ENGINE HIGH PRESSURE OXIDIZER TURBOPUMP SLINGER SEAL
James S. Voss *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 22 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 11A

N81-11996*# Wisconsin Univ., Platteville.
INCIPIENT FAILURE DETECTION (IFD) OF ANTIFRICTION BALL BEARINGS
David Y. Wang *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 24 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 13I

N81-12002*# Alabama A & M Univ., Normal.
POWER DISTRIBUTION FOR ELECTRON BEAM WELDING
Eugene Edwards *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 31 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 13H

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N81-11403# South Carolina Univ., Columbia. Dept. of Mathematics and Statistics.
ON ESTIMATION OF RELIABILITY FOR THE BIRNBAUM-SAUNDERS FATIGUE LIFE MODEL Interim Report
W. J. Padgett Jul. 1980 19 p refs
(Contract F49620-79-C-0140; AF Proj. 2304)
(AD-A089926; TR-64; AFOSR-80-0958TR) Avail: NTIS HC A02/MF A01 CSCL 20/11

The Birnbaum-Saunders fatigue life distribution with shape parameter alpha and scale parameter beta is considered. The scale parameter beta is also the median lifetime, and assuming that beta is known, Bayes estimators of the reliability function are obtained for a family of proper conjugate priors as well as for Jeffreys' vague prior for alpha. When both alpha and beta are unknown, a modified Bayes estimator R* sub B(t) of the reliability is proposed using a moment estimator of beta. In addition to being computationally simpler than the maximum likelihood estimator (mle) of reliability, Monte Carlo simulations for small samples show that R* sub B(t) is better than the method of moments estimator for all alpha and as good as the mle for small alpha in the sense of mean squared errors. GRA

N81-11404# Illinois Univ. at Chicago Circle, Chicago. Dept. of Mathematics.
MULTISTATE RELIABILITY MODELS: A SURVEY
Emad El-Neweihi Jul. 1980 24 p refs
(Contract AF-AFOSR-3050-76)
(AD-A089778) Avail: NTIS HC A02/MF A01 CSCL 14/4

The vast majority of reliability analyses assume that components and system are in either of two states: functioning or failed. In many real life situations one is capable of distinguishing between various 'levels of performance' for both the system and its components. For such cases, the existing dichotomous model is a gross oversimplification of the real situation and models representing multistate systems and components are more adequate. In the present paper, a survey is made of the recent papers which treat the more sophisticated and more realistic

situations in which components and systems may assume many states ranging from perfect functioning to complete failure. The present survey updates and complements a previous survey given by El-Neweihi and Proschan. GRA

N81-11405# Rockwell International Corp., Golden, Colo. Energy Systems Group.
QUALITY ENGINEERING AND CONTROL Semiannual Progress Report, May - Oct. 1979
Robert L. Carpenter 19 Aug. 1980 34 p refs
(Contract DE-AC04-76DP-03533)
(RFP-3015) Avail: NTIS HC A03/MF A01

Colorimetric determination of Ti in Cr, decontamination of metals by anodic dissolution, and computer code for X-ray peak identification are reported. Gel permeation chromatography of CoRezyn 1664 polyester resin, infrared monitoring of gases and vapors, and particle size analysis of dusts are discussed. Nondestructive analysis of Oralloy for removable alpha contamination, dissolution (digestion) of high fired oxides, assay of U in a Pu-U alloy, and measurement of oxide thickness on Pu metal by X-ray diffraction are described. Analysis of precipitated Pu peroxide, differentation of Dowex SBR and 11 resins, and determination of Pu solubility in simulated lung fluid are given. DOE

N81-11406# Science Applications, Inc., Palo Alto, Calif. Advanced Power Systems Div.
EXTENSION AND VALIDATION OF FAULT-TREE ANALYSIS FOR RELIABILITY PREDICTION
R. Land, L. Rayes, and E. T. Burns Sep. 1980 121 p refs
(EPRI-AP-1510) Avail: NTIS HC A06/MF A01

The reliability projection for a type of fossil fueled power plant which makes use of a combustion turbine and heat recovery steam generator in parallel operation with a package boiler is presented. The fault tree methodology was used to estimate both the mean plant reliability plus a confidence interval for the calculated reliability prediction. The input component failure rates, including the error bounds were updated from an integrated data base obtained from the best available data. The estimated reliability results using a model representative of the initial two years of plant operation were compared with the reliability from plant operating experience data for a similar period, and these are presented. The estimated reliability for continuous plant operation for 500 hours is in good agreement with the plant operating experience. It is concluded that the fault tree methodology can be applied directly to both the qualitative and quantitative prediction of power plant reliability. DOE

N81-11407# Los Alamos Scientific Lab., N. Mex.
RELIABILITY PROBLEMS IN POWER-GENERATION SYSTEMS
Maurice C. Bryson, Ed. 1980 24 p refs Presented at DOE Statist. Symp., Berkeley, Calif., 29-31 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2354; CONF-801045-1) Avail: NTIS HC A02/MF A01

Problems of reliability, safety, and dependability of power generation systems have increased public pressure for additional safety guarantees in power systems. The tendency has been to demand guarantees to zero risk, an attitude which both augments and is augmented by the slow growth ethic that has become familiar through the 1970s. Regardless of the merits of different political positions on these issues, it is essential to have a more precise understanding of the factors that are involved: specifically, that mathematical/statistical tools be developed and made available to potential users in order to quantify the magnitude of the risks inherent in using or failing to use competing technologies. Topics discussed include: estimation of very low failure probabilities; complex system reliability methodologies; dependence in failure modes; use of observational study data; communication of reliability data to nontechnical individuals; semiparametric procedures; estimating the reliability of man machine systems; degraded operation failure modes; pooling data; and accelerated data collection. DOE

N81-11408# Sandia Labs., Livermore, Calif. Acceptance Technology Div.
TRANSDUCER CHARACTERIZATION TECHNIQUES TO ENHANCE ADVANCED ULTRASONIC NONDESTRUCTIVE TESTING TECHNOLOGY
G. H. Thomas Aug. 1980 26 p refs Presented at the ASNT Fall Conf., Houston, Tex., 6-9 Oct. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-8733; CONF-801021-2) Avail: NTIS HC A03/MF A01

The role of the transducer has become even more important with the advent of computerized ultrasonic techniques. Applying advanced ultrasonic inspection technology, such as signal processing and pattern recognition, necessitates the determination of various, critical transducer parameters. A transducer characterization facility, that consists of an ultrasonic pulser/receiver, an oscilloscope, a spectrum analyzer and a Schlieren imaging system, is described and sample transducer characterizations are presented. DOE

N81-11409# Bendix Corp., Kansas City, Mo.
INSPECTION CONSIDERATIONS FOR HOLES 0.040 INCH AND SMALLER
Mar. 1980 27 p refs
(Contract DE-AC04-76DP-00613)
(BDX-613-2300) Avail: NTIS HC A03/MF A01

The accurate inspection of hole size and location for holes smaller than 0.040 inch necessitates several considerations beyond those normally encountered for larger holes. The technical aspects are described with emphasis on the use of mechanical size wires or gages and optical and flow rate approaches. DOE

N81-11410# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ULTRASONIC INSPECTABILITY IMPROVEMENTS OF AUSTENITIC STAINLESS STEEL WELDS AFTER THERMAL-MECHANICAL PROCESSING
Raj K. Malik and Layman A. Lott 1980 5 p Presented at the ASNT Fall Conf., Houston, Tex., 6 Oct. 1980
(Contract DE-AC07-76ID-01570)
(CONF-801021-3) Avail: NTIS HC A02/MF A01

A thermal mechanical process was applied to Type 304/308 stainless steel GTA welds. The process improved the ultrasonic transmission properties in the weld region. These improvements were attributed to the microstructural changes observed after processing of the austenitic stainless steel welds. Some of the microstructural changes observed were conversion of cast dendrites into equiaxed austenitic grains, and the reduction in size and number of stringers, inclusions, and delta ferrite. DOE

N81-11268# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
FAILURE DETECTION IN DYNAMIC SYSTEMS
Alan S. Willsky *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 14 p refs (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

N81-11270# Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France).
DETECTING THE FAILURE OF AIRCRAFT SENSORS USING ANALYTICAL REDUNDANCY [DETECTION DE PANNE DE CAPTEURS D'AVION PAR UTILISATION DE LA REDONDANCE ANALYTIQUE]
Marc Labarrere *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 17 p refs In FRENCH; ENGLISH summary (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

N81-11271*# SRI International Corp., Menlo Park, Calif. Computer Science Lab.
SOFTWARE VALIDATION AND VERIFICATION TECHNIQUES
Karl N. Levitt *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 9 p refs (For primary document see N81-11266 02-31)
(Contract NAS1-15528)
Avail: NTIS HC A08/MF A01 CSCL 09B

N81-11272# Honeywell Systems and Research Center, Minneapolis, Minn.
FAILURE MANAGEMENT TECHNIQUES FOR HIGH SURVIVABILITY
Thomas B. Cunningham *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 25 p refs (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

N81-11273# Saab-Scania, Linkoping (Sweden). Aerospace Div.
FAILURE MANAGEMENT FOR THE SAAB VIGGEN JA37 AIRCRAFT
Kjell Folkesson *In* AGARD Fault Tolerance Design and Redundancy Management Tech. Sep. 1980 21 p ref (For primary document see N81-11266 02-31)
Avail: NTIS HC A08/MF A01

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N81-11411 Wisconsin Univ. - Madison.
THE FRACTURE MECHANICS APPROACH TO THE ASSESSMENT OF ADHESIVE JOINT PERFORMANCE IN BONDED WOOD PRODUCTS Ph.D. Thesis
Robert Oboigbaotor Ebewele 1980 358 p
Avail: Univ. Microfilms Order No. 8015196

A test specimen which more accurately simulates the peripheral stresses experienced by structural adhesive joints in service was developed and used to monitor the effects of adhesive and adherend properties (due to changes in manufacturing variables) on adhesive joint quality. The bonding variables investigated included: bondline thickness, the orthotropic nature of wood, wood surface roughness, wood surface aging, adhesive chemistry and adhesive joint cure conditions. Fracture energy increased slowly with bondline thickness (in the range 160-100 microns) then jumped considerably (100-80 microns) and finally dropped sharply at bondline thickness less than 70 microns. Wood ansiotropy and aging of surface prior to bonding either by dry heat, kiln drying or storage significantly reduce joint performance. Viscosity control is probably the single most important factor that determines adhesive joint strength. Optimum joint performance is obtained by curing specimens at a temperature close to the reaction exotherm determined from DSC measurements. Dissert. Abstr.

N81-11412*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERHYBRID COMPOSITE BLADE IMPACT STUDIES
C. C. Chamis, R. F. Lark, and J. H. Sinclair [1980] 16 p refs *Proposed for presentation at the 26th Ann. Intern. Gas Turbine Conf., Houston, Tex., 9-12 Mar. 1981*
(NASA-TM-81597; E-580) Avail: NTIS HC A02/MF A01 CSCL 20K

The feasibility of superhybrid composite blades for meeting the mechanical design and impact resistance requirements of large fan blades for aircraft turbine engine applications was investigated. Two design concepts were evaluated: leading edge spar (TiCom) and center spar (TiCore), both with superhybrid composite shells. The investigation was both analytical and experimental. The results obtained show promise that superhybrid composites can be used to make light weight, high quality, large fan blades with good structural integrity. The blades tested successfully demonstrated their ability to meet steady state operating conditions, overspeed, and small bird impact requirements. A.R.H.

N81-11413*# Delaware Univ., Newark. Center for Composite Materials.
FAILURE ANALYSES OF COMPOSITE BOLTED JOINTS
D. W. Wilson, J. W. Gillespie, J. L. York, and R. B. Pipes Jul. 1980 79 p refs
(Grant NsG-1409)
(NASA-CR-163732; CCM-80-16) Avail: NTIS HC A05/MF A01 CSCL 20K

The complex failure behavior exhibited by bolted joints of graphite epoxy (Hercules AS/3501) was investigated for the net tension, bearing and shearout failure modes using combined analytical and experimental techniques. Plane stress, linear elastic, finite element methods were employed to determine the two dimensional state of stress resulting from a loaded hole in a finite width, semiinfinite strip. The stresses predicted by the finite element method were verified by experiment to lend credence to the analysis. The influence of joint geometric parameters on the state of stress and resultant strength of the joint was also studied. The resulting functional relationships found to exist between bolted joint strength and the geometric parameters, were applied in the formulation of semiempirical strength models for the basic failure modes. A point stress failure criterion was successfully applied as the failure criterion for the net tension and shearout failure modes. A.R.H.

N81-11414*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RECENT ADVANCES IN STRUCTURAL TECHNOLOGY FOR LARGE DEPLOYABLE AND ERECTABLE SPACECRAFT
Harold G. Bush and Walter L. Heard, Jr. Oct. 1980 23 p refs Presented at the 31st Congr. of the Intern. Astron. Federation, Tokyo, 21-27 Sep. 1980
(NASA-TM-81905; IAF-Paper-80-A-27) Avail: NTIS HC A02/MF A01 CSCL 20K

Ultra-low mass deployable and erectable truss structure designs for spacecraft are identified using computerized structural sizing techniques. Extremely slender strut proportions are shown to characterize minimum mass spacecraft which are designed for shuttle transport to orbit. Discrete element effects using a recently developed buckling theory for periodic lattice type structures are presented. An analysis of fabrication imperfection effects on the surface accuracy of four different antenna reflector structures is summarized. The tetrahedral truss has the greatest potential of the structures examined for application to accurate or large reflectors. A deployable module which can be efficiently transported is identified and shown to have significant potential for application to future antenna requirements. Investigations of erectable structure assembly are reviewed. S.F.

N81-11415# National Aerospace Lab., Amsterdam (Netherlands).
FLIGHT SIMULATION ENVIRONMENTAL FATIGUE CRACK PROPAGATION IN 2024-T3 AND 7475-T761 ALUMINUM
R. J. H. Wanhill Jan. 1980 10 p refs Presented at the 12th ICAS Congr., Munich, 12-17 Oct. 1980
(NLR-MP-80003-U; ICAF-1168) Avail: NTIS HC A02/MF A01

A gust spectrum representative of the load history of an under wing skin in a transport aircraft was used in flight simulation fatigue crack propagation tests on 2024-T3 and 7475-T761 aluminum alloy sheet. Tests were conducted at several design stress levels and in environments of air and air plus water spray. Results show that the fatigue crack propagation resistance of 2024-T3 sheet under gust spectrum loading is generally superior to that of 7475-T761 sheet, and that this superiority is mainly due to a greater amount of crack growth retardation during the less severe loads and flights that follow the peak loads in severe flights. The straightforward use of 7475 alloy in tension-critical structures like the under wing skin of a transport aircraft would result in decreased crack propagation resistance. In order to utilize the higher static structural efficiency and fracture toughness of 7475 alloy (in relation to 2024-T3), it may be possible to improve the relative performance by selecting an adhesive bonded laminated sheet or sandwich panel concepts. A.R.H.

N81-11416# National Aerospace Lab., Amsterdam (Netherlands).
TWO SIMPLE METHODS FOR DEFORMATION DEMONSTRATION AND MEASUREMENT
P. J. Sevenhuijsen Jan. 1980 14 p ref Presented at the 15th Ann. Conf. of the British Soc. for Strain Meas.: Pract. Strain Meas., Bristol, England, 3-6 Sep. 1979
(NLR-MP-80002-U; ICAF-1167) Avail: NTIS HC A02/MF A01

A photographic paper with a polyethylene-coated paper base offers an opportunity to produce test specimens provided with highly deformable high constrast grids. Ordinary objects like drinking straws and a film camera can be used for the study of the buckling phenomenon. Both methods are simple and can be used for deformation demonstration and measurement. A.R.H.

N81-11417*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD FOR ESTIMATING CRACK-EXTENSION RESISTANCE CURVE FROM RESIDUAL STRENGTH DATA
Thomas W. Orange Nov. 1980 15 p refs
(NASA-TP-1753; E-439) Avail: NTIS HC A02/MF A01 CSCL 20K

A method is presented for estimating the crack extension resistance curve (R curve) from residual strength (maximum load against initial crack length) data for precracked fracture specimens. The method allows additional information to be inferred from simple test results, and that information is used to estimate the failure loads of more complicated structures. Numerical differentiation of the residual strength data is required, and the problems that it may present are discussed. R.C.T.

N81-11418*# Lehigh Univ., Bethlehem, Pa.
STRESS INTENSITY FACTORS IN A HOLLOW CYLINDER CONTAINING A RADIAL CRACK
F. Delale Nov. 1980 27 p refs
(Grants NGR-39-007-011; NSF ENG-78-09737; Contract DOT-RC-82007)
(NASA-CR-163722) Avail: NTIS HC A03/MF A01 CSCL 20K

An exact formulation of the plane elasticity problem for a hollow cylinder or a disk containing a radial crack is given. The crack may be an external edge crack, an internal edge crack, or an embedded crack. It is assumed that on the crack surfaces the shear traction is zero and the normal traction is an arbitrary function of r. For various crack geometries and radius ratios, the numerical results are obtained for a uniform crack surface pressure, for a uniform pressure acting on the inside wall of the cylinder, and for a rotating disk. R.C.T.

N81-11419*# Lehigh Univ., Bethlehem, Pa.
CRACK PROBLEMS FOR A RECTANGULAR PLATE AND AN INFINITE STRIP
M. B. Civelek and F. Erdogan Jul. 1980 41 p refs
(Grants NGR-39-007-011; NSF ENG-78-09737)
(NASA-CR-163721) Avail: NTIS HC A03/MF A01 CSCL 20K

The general plane problem for an infinite strip containing multiple cracks perpendicular to its boundaries is considered. The problem is reduced to a system of singular integral equations. Two specific problems of practical interest are then studied in detail. The first problem explores the interaction effect of multiple edge cracks in a plate or beam under tension or bending. The second problem is that of a rectangular plate containing an arbitrarily oriented crack in the plane of symmetry. Particular emphasis is placed on the problem of a plate containing an edge crack and subjected to concentrated forces. R.C.T.

N81-11420*# Lehigh Univ., Bethlehem, Pa.
STRESSES IN ADHESIVELY BONDED JOINTS: A CLOSED FORM SOLUTION
F. Delale, F. Erdogan, and M. N. Aydinoglu Aug. 1980 31 p refs
(Grants NGR-39-007-011; NSF ENG-78-09737)
(NASA-CR-163720) Avail: NTIS HC A03/MF A01 CSCL 20K

The plane strain of adhesively bonded structures which consist of two different orthotropic adherents is considered. Assuming that the thicknesses of the adherends are constant and are small in relation to the lateral dimensions of the bonded region, the adherends are treated as plates. The transverse shear effects in the adherends and the in-plane normal strain in the adhesive are taken into account. The problem is reduced to a system of differential equations for the adhesive stresses which is solved in closed form. A single lap joint and a stiffened plate under various loading conditions are considered as examples. To verify the basic trend of the solutions obtained from the plate theory a sample problem is solved by using the finite element method and by treating the adherends and the adhesive as elastic continua. The plate theory not only predicts the correct trend for the adhesive stresses but also gives rather surprisingly accurate results. A.R.H.

N81-11421*# Lehigh Univ., Bethlehem, Pa.
STRESS SINGULARITIES AT THE VERTEX OF A CYLINDRICALLY ANISOTROPIC WEDGE
F. Delale, F. Erdogan, and H. Boduroglu Aug. 1980 19 p refs
(Grants NGR-39-007-011; NSF ENG-78-09737)
(NASA-CR-163719) Avail: NTIS HC A02/MF A01 CSCL 20K

The plane elasticity problem for a cylindrically anisotropic solid is formulated. The form of the solution for an infinite wedge shaped domain with various homogeneous boundary conditions is derived and the nature of the stress singularity at the vertex of the wedge is studied. The characteristic equations giving the stress singularity and the angular distribution of the stresses around the vertex of the wedge are obtained for three standard homogeneous boundary conditions. The numerical examples show that the singular behavior of the stresses around the vertex of an anisotropic wedge may be significantly different from that of the isotropic material. Some of the results which may be of practical importance are that for a half plane the stress state at r = 0 may be singular and for a crack the power of stress singularity may be greater or less than 1/2. Author

N81-11422*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ANALYTICAL TECHNIQUE FOR APPROXIMATING UNSTEADY AERODYNAMICS IN THE TIME DOMAIN
H. J. Dunn Nov. 1980 31 p refs
(NASA-TP-1738; L-13255) Avail: NTIS HC A03/MF A01 CSCL 20K

An analytical technique is presented for approximating unsteady aerodynamic forces in the time domain. The order of elements of a matrix Pade approximation was postulated, and the resulting polynomial coefficients were determined through a combination of least squares estimates for the numerator coefficients and a constrained gradient search for the denominator coefficients which insures stable approximating functions. The number of differential equations required to represent the aerodynamic forces to a given accuracy tends to be smaller than that employed in certain existing techniques where the denominator coefficients are chosen a priori. Results are shown for an aeroelastic, cantilevered, semispan wing which indicate a good fit to the aerodynamic forces for oscillatory motion can be achieved with a matrix Pade approximation having fourth order numerator and second order denominator polynomials. Author

N81-11423# Army Armament Research and Development Command, Watervliet, N. Y.
STRAIN BEHAVIOR OF PRESSURIZED CRACKED THICK WALLED CYLINDERS
J. F. Throop and R. R. Fujczak Aug. 1980 32 p refs Submitted for publication
(DA Proj. 1L1-62105-AH-84)
(AD-A090004; AD-E440092; ARLCB-TR-80029) Avail: NTIS HC A03/MF A01 CSCL 20/11

External circumferential strains were measured on large thick wall pressure vessels containing internal fatigue cracks, using bonded strain gages. When strains measured over the cracks become compressive they predict impending failure. Normalization by the Lame strain relates them to the fraction of fatigue life consumed and provides estimates of longevity. GRA

N81-11424# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEVELOPMENT OF A UNIFIED NUMERICAL PROCEDURE FOR FREE VIBRATION ANALYSIS STRUCTURES Final Report, Feb. 1977 - Jan. 1980
K. K. Gupta 21 Aug. 1980 7 p refs
(Grant AF-AFOSR-3276-77)
(AD-A089946; AFOSR-80-0953TR) Avail: NTIS HC A02/MF A01 CSCL 20/11

The article presents the details of new numerical techniques

developed in connection with the AFOSR grant. Thus a numerical algorithm and a computer program have been successfully developed for the efficient and economical solution of structural eigenvalue problems. Both spinning and nonspinning structures with and without viscous and/or structural damping may be analyzed by the routine. The program fully exploits matrix sparsity associated with the finite and finite dynamics element formulation. In particular, effective solution of the quadratic matrix eigenvalue problem has been implemented for the development of finite dynamic elements. A special symmetric matrix decomposition scheme has been adopted for matrix triangularization that renders the program rather efficient. Also, a novel bisection scheme has been developed that further accelerates the solution convergence rate, particularly for the case of repeated roots. Further, as a special case, the routine solves static problems with multiple load cases. The associated computer program EIGSOL employs an out-of-core solution strategy, enabling effective solutions to be achieved for large, complex, practical structures. A listing of the program written in FORTRAN V for the UNIVAC 1100/82 along with the source deck is available for ready use. GRA

N81-11425# Army Armament Research and Development Command, Watervliet, N. Y. Large Caliber Weapon Systems Lab.

ANALYSIS OF SHIFTS IN THE POINTS OF MAXIMUM DEFLECTION AND PERMANENT DEFLECTION FOR ELASTIC-PLASTIC BENDING OF UNSYMMETRICALLY LOADED BEAMS

R. V. Milligan 8 Aug. 1980 24 p refs
(DA Proj. 1L1-62105-AH-84)
(AD-A090006; AD-E440089) Avail: NTIS HC A02/MF A01 CSCL 20/11

An analysis of elastic-plastic bending of unsymmetrically loaded beams is carried out using the method of virtual work. The results show that the maximum deflection under load occurs at quite some distance from the point of loading but moves toward the point of loading as the load approaches ultimate. The residual or permanent deflections occur at points different from those developed under load and are shifted further toward the load point. However, even at a load equal to 99.5% of the ultimate the maximum permanent deflection still occurs at a considerable distance from the point of loading. The maximum strains (under load) and the permanent strains occur at the point where the load is applied. GRA

N81-11426# Naval Research Lab., Washington, D. C.

A REVIEW OF FATIGUE CRACK GROWTH OF PRESSURE VESSEL AND PIPING STEELS IN HIGH-TEMPERATURE, PRESSURIZED REACTOR-GRADE WATER Interim Report

W. H. Cullen 19 Sep. 1980 127 p refs
(Contracts NRC-RES-79-103; NRC-FIN-B-5528)
(AD-A089697; NRL-MR-4298; NUREG-CR-1576) Avail: NTIS HC A07/MF A01 CSCL 11/6

Fatigue crack growth data sets, for pressure vessel and piping steels, in reactor-grade water environment have appeared in various reports and publications since about 1972. All of the results which have been published from 1972 through 1979 have been plotted and are presented in this report. Beginning with a discussion of the need for these data, and an explanation of the laboratory facilities which are required for this research, this report goes on to describe the overall trends which have evolved through consideration of the data sets and the conditions under which they were generated. A model for hydrogen assisted fatigue crack growth is described and applied to the pressurized water reactor type of environment. A complete listing of references is included in the report. GRA

N81-11427# Bell Aerospace Co., Buffalo, N. Y. Advanced Mobility Systems Dept.

FORCE METHOD OPTIMIZATION Final Report, Jun. 1977 - Dec. 1979

R. A. Gellatly and Richard D. Thom Feb. 1980 99 p refs
(Contract F33615-77-C-3032; AF Proj. 2307)
(AD-A089795; AFWAL-TR-80-3006) Avail: NTIS HC A05/MF A01 CSCL 20/11

To overcome problems arising from the rigorous representation of stress constraints in structural optimization, the use of the force method is demonstrated. The force method of finite element analysis is used to transform a stress-constrained redundant structure into a stress and displacement constrained determinate structure for the purposes of optimization. The resulting problem is non-linear, but the use of a linear programming stage is effective in providing a rapid convergence on the optimum design in many cases. Problems which hitherto required many iterations to converge are now solvable in only one or two steps. The rate of constraint numbers versus numbers of variables is investigated analytically using a 22 bar truss problem as an example. The vital key in optimization technology is identified as the identification of active constraints. The incorporation of displacement constraints into the optimization program is also presented. Examples of problems solved by this approach are included. Discussion of difficulties encountered in the development work also provides indicators for future areas of research. GRA

N81-11428# Los Alamos Scientific Lab., N. Mex.

COMPARISON OF FINITE-ELEMENT STRESS ANALYSIS WITH EXPERIMENTAL COPPER SPHERE IMPACTS

C. E. Frantz, S. S. Hecker, M. G. Stout, and R. V. Browning Jul. 1980 22 p refs
(Contract W-7405-eng-36)
(LA-8296) Avail: NTIS HC A02/MF A01

Three copper spheres were impacted on targets of varying surface finishes at 100 m/sec. Impact face friction was varied for each test and the impact was photographed with a high speed camera. Postimpact strains and deformation were measured. A finite element computer code, NONSAP, was used to model the impact. The best agreement between computer prediction and experiment was obtained using isoparametric elements, a graded mesh, and actual high strain rate copper stress strain data. Frictional conditions at the impact face were also modeled by altering the standard NONSAP code. The most critical test of NONSAP was accurate prediction of experimental impact strains. The best agreement had a maximum point to point error of 20%, although in general, the comparison was much better. DOE

N81-11429# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

CREEP-FATIGUE EFFECTS IN STRUCTURAL MATERIALS USED IN ADVANCED NUCLEAR POWER GENERATING SYSTEMS

C. R. Brinkman 1980 23 p refs Presented at the 27th Sagamore Army Materials Conf., Bolton Landing, N.Y., 14 Jul. 1980
(Contract W-7405-eng-26)
(CONF-800741-1) Avail: NTIS HC A02/MF A01

Various aspects of time dependent fatigue behavior of a number of structural alloys in use or planned for use in advanced nuclear power generating systems are reviewed. Materials included are types 304 and 316 stainless steel, Fe-2 1/4 Cr-1 Mo steel and alloy 800 H. Examples of environmental effects, including both chemical and physical interaction, are presented for a number of environments. The environments discussed are high purity liquid sodium, high vacuum, air, impure helium, and irradiation damage, including internal helium bubble generations. DOE

N81-11430# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.

CRACK ANALYSIS, GLASS-CERAMIC INSULATOR OF VACUUM TUBE

R. K. Spears 25 Aug. 1980 23 p ref
(Contract DE-AC04-76DP-00656)
(GEPP-TIS-511) Avail: NTIS HC A02/MF A01

The high voltage glass-ceramic insulators from ten vacuum tubes that had failed a bubble leak test were analyzed to determine the cause. All insulators exhibited a similar crack pattern. It appeared that the primary crack initiated at a point near the top of the insulator and resulted in a fracture that radiated from the inner sleeve of the tube to the outer frame. These cracks were duplicated on subassemblies by applying heat to the inner sleeve near the top surface of the insulator. It was determined that the cracks resulted from heating problems associated with the source closure braze. It was determined that misalignment of the radio frequency braze coil caused cracking of assemblies. DOE

N81-11431# Ames Lab., Iowa. Dept. of Engineering Mechanics.
STRESS CONCENTRATION FACTORS DUE TO FLAWS NEAR THE EDGE OF A PLATE UNDER TENSION M.S. Thesis
Jill Surgi Hanus 1980 62 p refs
(Contract W-7405-eng-82)
(IS-T-928) Avail: NTIS HC A04/MF A01

The relation of near-edge flaws to structural reliability was investigated. The effect of ligament fracture for circular and elliptical holes was examined and the resulting surface breaking flaw and its relationship to a standard U-shaped notch were investigated using photoelastic techniques. DOE

N81-11432# Ames Lab., Iowa.
CRACK DEPTH DETERMINATION BY ULTRASONIC FREQUENCY ANALYSIS AIDED BY DYNAMIC PHOTOELASTICITY M.S. Thesis
Anmol Singh Aug. 1980 117 p refs
(Contract W-7405-eng-82)
(IS-T-900) Avail: NTIS HC A06/MF A01

A nondestructive method for characterizing the depth of artificial surface breaking flaws (slots) using Rayleigh surface waves is described. Dynamic photoelasticity was used to obtain a full field visualization of the waves generated on interaction of a Rayleigh wave with a slot. This visualization showed that for slot lengths of the same order of size as the predominant wavelengths in the incident Rayleigh wave, there is a significant interaction of the subsurface disturbance with the slot tip, producing transmitted surface disturbances that were quantitatively analyzed. The frequency content of these transmitted waves was found for four different slot depths. Ultrasonic testing was also done on surface slots in steel blocks, using commercial Rayleigh wave transducers. A relationship similar to the photoelastic results was obtained for the frequency components of the transmitted waves at the surface relative to the slot depth. However, in the ultrasonic case, there was a definite high frequency cut off point which could be directly related to the slot depth for slots perpendicular to the surface. DOE

N81-11433# Sandia Labs., Albuquerque, N. Mex. Vibration and Model Testing Div.
SWEPT NARROW BAND RANDOM ON RANDOM
F. Thomas Mercer Aug. 1980 34 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-1534) Avail: NTIS HC A03/MF A01

The implementation of swept narrow band random on random on the HP5451C Fourier Analyzer System and the HP5427A Vibration Control System is discussed. Up to five narrow bands of a dynamically changing narrow band random spectrum were super-imposed on a broad band random spectrum and swept at various rates to simulate field environments. DOE

N81-11434# Sandia Labs., Albuquerque, N. Mex. Systems Safety Technology Div.
TRANSIENT RESPONSE OF A SINGLE-EDGE CRACK IN AN ELASTIC HALF-PLANE
E. P. Chen 1980 15 p refs Presented at the U.S.-Greece Symp. on Mixed Mode Crack Propagation, Athens, 18 Aug. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-1877C; CONF-800846-1) Avail: NTIS HC A02/MF A01

The elasto-dynamic response of a single-edge crack in a semi-infinite elastic medium is considered. The crack was assumed to appear suddenly in an elastic half-plate that was being stretched by a remote stress field. Near the crack, the interactions between the wave emanating from the tip and those reflected from the free edge take place. The determination of the effect of this interaction on the stress intensity factor is described. Laplace and Fourier transforms were used to reduce the solution to a pair of dual integral equations. A numerical Laplace inversion procedure was used to obtain the time dependence of the solution. Numerical results on the dynamic stress intensity factor were obtained and are presented in a graphical form. DOE

N81-11435# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
MECHANICAL PROPERTIES TEST DATA FOR STRUCTURAL MATERIALS Semiannual Progress Report
D. D. Keiser 1980 35 p refs
(Contract DE-AC07-76ID-01570)
(DOE/ID-01570/T10) Avail: NTIS HC A03/MF A01

Mechanical properties of alloy 718 given either the 954 C conventional or the INEL heat treatment were investigated. Conventional heat-treat data included tests showing the effects of surface finish, product variability, and thermal exposure on high-cycle fatigue properties; creep-fatigue tests at 538, 593, 649, and 704 C with 0.1 hour hold times at peak strain; and stress-rupture tests of notched and smooth specimens showing the effect of pretest thermal exposure. A few stress-rupture tests of weld and base metals given the INEL heat treatment are also reported. High-cycle fatigue tests of Type 316 stainless steel at 593 C are reported and compared with previous data. DOE

N81-12007*# South Carolina Univ., Columbia.
IMPROVEMENTS TO THE NASAP CODE
David Perel *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 76 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20K

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N81-11436*# Arizona Univ., Tucson. Optical Sciences Center.
FEASIBILITY STUDY CONSISTING OF A REVIEW OF CONTOUR GENERATION METHODS FROM STEREOGRAMS
Cheol-Jung Kim and James C. Wyant Aug. 1980 23 p refs
(Contract JPL-955667)
(NASA-CR-163716) Avail: NTIS HC A02/MF A01 CSCL 14E

A review of techniques for obtaining contour information from stereo pairs is given. Photogrammetric principles including a description of stereoscopic vision are presented. The use of conventional contour generation methods, such as the photogrammetric plotting technique, electronic correlator, and digital correlator are described. Coherent optical techniques for contour generation are discussed and compared to the electronic correlator. The optical techniques are divided into two categories: (1) image plane operation and (2) frequency plane operation. The description of image plane correlators are further divided into three categories: (1) image to image correlator, (2) interferometric correlator, and (3) positive negative transparencies. The frequency plane correlators are divided into two categories: (1) correlation of Fourier transforms, and (2) filtering techniques. Author

N81-11437*# Arkansas Univ., Fayetteville.
EVALUATION OF AIRCRAFT MICROWAVE DATA FOR LOCATING ZONES FOR WELL STIMULATION AND ENHANCED GAS RECOVERY Final Report
H. MacDonald, W. Waite, C. Elachi, R. Babcock, R. Konig, J. Gattis, M. Borengasser, and D. Tolman Jan. 1980 130 p refs
(Contract JPL-955048)
(NASA-CR-163710) Avail: NTIS HC A07/MF A01 CSCL 08G

Imaging radar was evaluated as an adjunct to conventional petroleum exploration techniques, especially linear mapping. Linear features were mapped from several remote sensor data sources including stereo photography, enhanced LANDSAT imagery, SLAR radar imagery, enhanced SAR radar imagery, and SAR radar/LANDSAT combinations. Linear feature maps were compared with surface joint data, subsurface and geophysical data, and gas production in the Arkansas part of the Arkoma basin. The best LANDSAT enhanced product for linear detection was found to be a winter scene, band 7, uniform distribution stretch. Of the individual SAR data products, the VH (cross polarized) SAR radar mosaic provides for detection of most linears; however, none of the SAR enhancements is significantly better than the others. Radar/LANDSAT merges may provide better linear detection than a single sensor mapping mode, but because of operator variability, the results are inconclusive. Radar/LANDSAT combinations appear promising as an optimum linear mapping technique, if the advantages and disadvantages of each remote sensor are considered. Author

N81-11438*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.

NASA WALLOPS FLIGHT CENTER GEOS-3 ALTIMETER DATA PROCESSING REPORT

H. R. Stanley and R. E. Dwyer (Computer Sciences Corp., Wallops Island, Va.) Nov. 1980 131 p refs Supersedes NASA-TM-X-69357

(NASA-RP-1066) Avail: NTIS HC A07/MF A01 CSCL 17I

The procedures used to process the GEOS-3 radar altimeter data from raw telemetry data to a final user data product are described. In addition, the radar altimeter hardware design and operating parameters are presented to aid the altimeter user in understanding the altimeter data. Author

N81-11439*# Texas A&M Univ., College Station. Remote Sensing Center.

THE SOFTWARE SYSTEM DEVELOPMENT FOR THE TAMU REAL-TIME FAN BEAM SCATTEROMETER DATA PROCESSORS Final Report

Billy V. Clark and B. Randall Jean Aug. 1980 262 p refs (Contract NAS9-15311)

(NASA-CR-160880; RSC-3556-2) Avail: NTIS HC A12/MF A01 CSCL 08B

A software package was designed and written to process in real-time any one quadrature channel pair of radar scatterometer signals form the NASA L- or C-Band radar scatterometer systems. The software was successfully tested in the C-Band processor breadboard hardware using recorded radar and NERDAS (NASA Earth Resources Data Annotation System) signals as the input data sources. The processor development program and the overall processor theory of operation and design are described. The real-time processor software system is documented and the results of the laboratory software tests, and recommendations for the efficient application of the data processing capabilities are presented. A.R.H.

N81-11440*# National Aeronautics and Space Administration, Washington, D. C.

SOURCES FOR LANDSAT ASSISTANCE AND SERVICES. MODULE U-5

Jan. 1980 41 p

(NASA-TM-80936) Avail: NTIS HC A03/MF A01 CSCL 05B

Directories of academic and commercial sources to assist the potential users of LANDSAT data and products are presented. In addition, points of contact for federal and state agencies are provided. L.F.M.

N81-11441# Tetra Tech, Inc., Pasadena, Calif.

A NUMERICAL MODEL FOR PREDICTING SHORELINE CHANGES

Bernard Le. Mehaute and Mills Soldate Jul. 1980 74 p refs (AD-A090133; TETRAT-TC-831A; CERC-MR-80-6) Avail: NTIS HC A04/MF A01 CSCL 08/6

A mathematical model for long-term, three dimensional shoreline evolution is developed. The combined effects of variations of sea level; wave refraction and diffraction; loss of sand by density currents during storms, by rip currents, and by wind; bluff erosion and berm accretion; effects of manmade structures such as long groin or navigational structures; and beach nourishment are all taken into account. A computer program is developed with various subroutines which permit modification as the state-of-the-art progresses. The program is applied to a test case at Holland Harbor, Michigan. GRA

N81-11442# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

REVIEW OF TECHNIQUES FOR MEASURING SOIL MOISTURE IN SITU

H. L. McKim, J. E. Walsh, and D. N. Arion Aug. 1980 22 p refs

(AD-A089974; CRREL-SR-80-31) Avail: NTIS HC A02/MF A01 CSCL 08/13

Recently there has been an increased interest in the in-situ measurement of soil moisture content in the areas of hydrology, meteorology, agriculture and environmental studies. Current methods generally have limitations, depending upon the use of the data, that greatly influence acquisition and reliability of the soil moisture determination. This report discusses gravimetric, nuclear, electromagnetic, tensiometric and hygroscopic techniques and the advantages and disadvantages of using the technique. Emphasis is placed on the tensiometric and electromagnetic techniques. These two measurements when coupled together would supply information on the wetting and drying soil moisture characteristic curves and thereby provide a means of tracing moisture movement under field conditions in cold climates. GRA

N81-11443# Los Alamos Scientific Lab., N. Mex.

STATISTICAL TECHNIQUES APPLIED TO AERIAL RADIOMETRIC SURVEYS (STAARS): PERCENTILE ESTIMATION WITH THE NORMAL AND LOGNORMAL DISTRIBUTIONS

Thomas R. Bement and Frederick L. Pirkle Jun. 1980 28 p refs Prepared in cooperation with Bendix Field Engineering Corp., Grand Junction, Colo.

(Contracts DE-AC13-76GJ-01664; W-7405-eng-36)

(GJBX-123-80) Avail: NTIS HC A03/MF A01

Because of the prominence of percentile estimation in the analysis of NURE aerial radiometric data, a study was conducted to compare two methods of estimating percentiles. The two methods of estimation considered are (1) the normal distribution assumption method and (2) the lognormal distribution assumption method. An error made by assuming the data are from a normal population, when in fact the population is lognormal, causes problems primarily when estimating tail percentiles. When estimating upper percentiles, the error of assuming lognormality, when the data are really normal, has more serious consequences than does the error of assuming normality, when the data are lognormal. When estimating lower tail percentiles, the error of failing to perform a log-transformation has more serious consequences than does the error of transforming. DOE

N81-11444# California Univ., Riverside. Dept. of Soil and Environmental Sciences.

USES OF TREE LEGUMES IN SEMI-ARID REGIONS

Peter Felker 1980 29 p refs Presented at the Soc. for Econ. Botany Symp. on Legumes, Bloomington, Ind., Jun. 1980 (Contract DE-FG01-78ET-20023)

(CONF-8006100-1) Avail: NTIS HC A03/MF A01

Uses of tree legumes in semi-arid and arid regions are reviewed. This review is divided into sections according to the following general use categories: fuels; human food; livestock food; to increase yields of crops grown beneath their canopies; and control of desertification. DOE

N81-11445# Department of Energy, Washington, D. C. Energy Information Administration.

BITUMINOUS COAL AND LIGNITE PRODUCTION AND MINE OPERATIONS, 1978 Energy Data Report

Clyde Boykins Jun. 1980 90 p ref

(DOE/EIA-0118/78) Avail: NTIS HC A05/MF A01

In 1978 bituminous coal and lignite US production totaled 665.1 million tons, a decline of about 3.8 percent from the alltime high of 691.3 million tons in 1977. The drop in production in 1978 was largely the result of the coal miners' strike that began December 6, 1977 and continued until March 25, 1978. Production from underground mines in 1978 totaled 242.2 million

tons, down 8.9 percent from 266.0 million tons the previous year. Production from surface mines decreased to 423.0 million tons, 0.6 percent below the 425.4 million tons reported in 1977. The average price of coal (F.O.B. mines) rose 9.8 percent to $21.78 per ton from $19.82 per ton in 1977. At underground mines the average price was $30.94 per ton, up 9.5 percent from $28.25 per ton the previous year. At surface mines it increased 13.5 percent to $16.53 per ton from $14.56 per ton in 1977. The average number of miners employed rose 9.4 percent to 242.295 from 221,428 in 1977. DOE

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N81-11446 Missouri Univ. -Columbia.
AN ANALYSIS OF PERCEPTUAL RESPONSES TO SOLAR ENERGY ADAPTATION IN RESIDENTIAL DESIGN Ph.D. Thesis
Jo Ann Asher Thompson 1979 192 p
Avail: Univ. Microfilms Order No. 8024402

In order to investigate the manner in which people perceive their built environment with and without an adaptation for solar energy, a questionnaire was developed which consisted of fifteen adjective pairs, called a semantic differential. Each of the adjective pairs represent opposites of each other; i.e., large versus small. A sample was taken of 181 people from those attending the 1979 Columbia, Missouri Home Show. From the analysis of variance and the multivariate analysis of variance, it was found that on the perceptual level, there was little to no difference between the solar and the nonsolar residence. In other words, the responses of the individuals did not show anything statistically significant in the manner in which people perceived the solar and the nonsolar representation. Dissert. Abstr.

N81-11447*# General Electric Co., Schenectady, N. Y. Energy Technology Operation.
COGENERATION TECHNOLOGY ALTERNATIVES STUDY (CTAS). VOLUME 5: COGENERATION SYSTEMS RESULTS Final Report
H. E. Gerlaugh, E. W. Hall, , D. H. Brown, R. R. Priestley, and W. F. Knightly May 1980 175 p refs
(Contract DEN3-31)
(NASA-CR-159769; DOE/NASA/0031-80/5; GE80ET0102) Avail: NTIS HC A08/MF A01 CSCL 10B

The use of various advanced energy conversion systems is examined and compared with each other and with current technology systems for savings in fuel energy, costs, and emissions in individual plants and on a national level. About fifty industrial processes from the largest energy consuming sectors were used as a basis for matching a similar number of energy conversion systems that are considered as candidate which can be made available by the 1985 to 2000 time period. The sectors considered included food, textiles, lumber, paper, chemicals, petroleum, glass, and primary metals. The energy conversion systems included steam and gas turbines, diesels, thermionics, stirling, closed cycle and steam injected gas turbines, and fuel cells. Fuels considered were coal, both coal and petroleum based residual and distillate liquid fuels, and low Btu gas obtained through the on site gasification of coal. The methodology and results of matching the cogeneration energy conversion systems to approximately 50 industrial processes are described. Results include fuel energy saved, levelized annual energy cost saved, return on investment, and operational factors relative to the noncogeneration base cases. J.M.S.

N81-11448*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A STEEL SPAR WIND TURBINE BLADE ON THE MOD-0 100 kW EXPERIMENTAL WIND TURBINE Final Report
Theo G. Keith, Jr. (Toledo Univ.), Timothy L. Sullivan, and Larry A. Viterna Sep. 1980 24 p refs
(Contract EX-76-I-01-1028)
(NASA-TM-81588; DOE/NASA/1028-27; E-567) Avail: NTIS HC A02/MF A01 CSCL 10B

The performance and loading of a large wind rotor, 38.4 m in diameter and composed of two low-cost steel spar blades were examined. Two blades were fabricated at Lewis Research Center and successfully operated on the Mod-0 wind turbine at Plum Brook. The blades were operated on a tower on which the natural bending frequency were altered by placing the tower on a leaf-spring apparatus. It was found that neither blade performance nor loading were affected significantly by this tower softening technique. Rotor performance exceeded prediction while blade loads were found to be in reasonable agreement with those predicted. Seventy-five hours of operation over a five month period resulted in no deterioration in the blade. Author

N81-11449*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRIC AND HYBRID VEHICLE SYSTEM R/D
Harvey J. Schwartz 17 Sep. 1980 15 p refs Presented at Intern. Conf. on Transportation Electron., Dearborn, Michigan, 15-17 Sep. 1980; sponsored by the Vehicle Technol. Soc. and Inst. of Elec. and Electron. Engr. and Soc. of Automotive Engr. and Inst. of Elec. Engr.
(Contract DE-AI01-77CS-51044)
(NASA-TM-81606; E-599; DOE/NASA/51044-11) Avail: NTIS HC A02/MF A01 CSCL 10B

The work being done to characterize the level of current propulsion technology through component testing is described. Important interactions between the battery and the propulsion system will be discussed. Component development work, involving traction motors, motor controllers and transmissions are described and current results are presented. Studies of advanced electric and hybrid propulsion system studies are summarized and the status of propulsion system development work supported by the project is described. A strategy for fostering joint industry/government projects for commercialization of propulsion components and systems is described briefly. T.M.

N81-11450*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Materials Engineering.
IDENTIFICATION AND ANALYSIS OF FACTORS AFFECTING THERMAL SHOCK RESISTANCE OF CERAMIC MATERIALS IN SOLAR RECEIVERS Final Report
D. P. H. Hasselman, J. P. Singh, and K. Satyamurthy 15 Jul. 1980 150 p refs
(Contracts NAS7-100; JPL-955629)
(NASA-CR-163727; JPL-9950430) Avail: NTIS HC A07/MF A01 CSCL 10A

An analysis was conducted of the possible modes of thermal stress failure of brittle ceramics for potential use in point-focussing solar receivers. The pertinent materials properties which control thermal stress resistance were identified for conditions of steady-state and transient heat flow, convective and radiative heat transfer, thermal buckling and thermal fatigue as well as catastrophic crack propagation. Selection rules for materials with optimum thermal stress resistance for a particular thermal environment were identified. Recommendations for materials for particular components were made. The general requirements for a thermal shock testing program quantitatively meaningful for point-focussing solar receivers were outlined. Recommendations for follow-on theoretical analyses were made. Author

N81-11451*# Cornell Univ., Ithaca, N. Y. Materials Science and Engineering.
DEFECT STRUCTURE OF WEB SILICON RIBBON
B. Cunningham, H. Strunk, and D. Ast Oct. 1980 23 p refs
(Contract JPL-954852)
(NASA-CR-163709; DOE/JPL-954852-80/5) Avail: NTIS HC A02/MF A01 CSCL 10A

The results of a preliminary study of two dendritic web samples

are presented. The structure and electrical activity of the defects in the silicon webs were studied. Optical microscopy of chemically etched specimens was used to determine dislocation densities. Samples were mechanically polished, then Secco etched for approximately 5 minutes. High voltage transmission electron microscopy was used to characterize the crystallographic nature of the defects. T.M.

N81-11452*# Kulicke and Sofa Industries, Inc., Horsham, Pa.
AUTOMATED SOLAR MODULE ASSEMBLY LINE Final Report
Max Bycer Aug. 1980 105 p refs Prepared for JPL
(Contract JPL-955287)
(NASA-CR-163726; DOE/JPL-955287-80/6; JPL-9950-438)
Avail: NTIS HC A06/MF A01 CSCL 10A

The solar module assembly machine which Kulicke and Soffa delivered under this contract is a cell tabbing and stringing machine, and capable of handling a variety of cells and assembling strings up to 4 feet long which then can be placed into a module array up to 2 feet by 4 feet in a series of parallel arrangement, and in a straight or interdigitated array format. The machine cycle is 5 seconds per solar cell. This machine is primarily adapted to 3 inch diameter round cells with two tabs between cells. Pulsed heat is used as the bond technique for solar cell interconnects. The solar module assembly machine unloads solar cells from a cassette, automatically orients them, applies flux and solders interconnect ribbons onto the cells. It then inverts the tabbed cells, connects them into cell strings, and delivers them into a module array format using a track mounted vacuum lance, from which they are taken to test and cleaning benches prior to final encapsulation into finished solar modules. Throughout the machine the solar cell is handled very carefully, and any contact with the collector side of the cell is avoided or minimized. Author

N81-11453*# Optical Coating Lab., Inc., City of Industry, Calif. Photoelectronics Div.
DEVELOPMENT OF LOW COST CONTACTS TO SILICON SOLAR CELLS Final Report, 15 Oct. 1978 - 30 Apr. 1980
D. P. Tanner and P. A. Iles 30 Apr. 1980 125 p refs
(Contract JPL-955244)
(NASA-CR-163725; DOE/JPL-955244-80/5; JPL-9950-424)
Avail: NTIS HC A06/MF A01 CSCL 10A

A copper based contact system using plated Pd-Cr-Cu was developed. Good cells were made but cells degraded under low temperature (300 C) heat treatments. The degradation was identified as copper migration into the cells junction region. A paper study was conducted to find a proper barrier to the copper migration problem. Nickel was identified as the best candidate barrier and this was verified in a heat treatment study using evaporated metal layers. An electroless nickel solution was substituted for the electroless chromium solution in the original process. T.M.

N81-11454*# Spire Corp., Bedford, Mass.
DESIGN, FABRICATION, TEST QUALIFICATION AND PRICE ANALYSIS OF THIRD GENERATION DESIGN SOLAR CELL MODULES Final Design Report
Michael J. Nowlan Sep. 1980 104 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955405)
(NASA-CR-163708; JPL-9950-420; DOE/JPL-955405-80/1)
Avail: NTIS HC A06/MF A01 CSCL 10A

A JPL qualified, high efficiency block 4 solar module with a power density of 125 W/sq m at 28 C was developed and manufactured. The module design is described as well as experiments conducted during the development phase of the program. The rationale for each major component choice is given and the quality assurance plan is outlined. Data on cell and module fabrication and on the performance and yield of the modules are presented. Testing, both to determine module characteristics and to establish JPL qualifications are discussed. The results of the SAMIS cost analysis are included. A.R.H.

N81-11455*# Missouri Univ. -Rolla. Dept. of Ceramic Engineering.
EFFECTS OF VARYING OXYGEN PARTIAL PRESSURE ON MOLTEN SILICON-CERAMIC SUBSTRATE INTERACTIONS Final Report
Darrell P. Ownby and Michael W. Barsoum Apr. 1980 36 p refs Prepared for JPL Sponsored in part by DOE
(Contract JPL-955415)
(NASA-CR-163718; JPL-955415-80/2;
DOE/JPL-955415-80/2) Avail: NTIS HC A03/MF A01 CSCL 10A

The silicon sessile drop contact angle was measured on hot pressed silicon nitride, silicon nitride coated on hot pressed silicon nitride, silicon carbon coated on graphite, and on Sialon to determine the degree to which silicon wets these substances. The post-sessile drop experiment samples were sectioned and photomicrographs were taken of the silicon-substrate interface to observe the degree of surface dissolution and degradation. Of these materials, silicon did not form a true sessile drop on the SiC on graphite due to infiltration of the silicon through the SiC coating, nor on the Sialon due to the formation of a more-or-less rigid coating on the liquid silicon. The most wetting was obtained on the coated Si3N4 with a value of 42 deg. The oxygen concentrations in a silicon ribbon furnace and in a sessile drop furnace were measured using the protable thoria-yttria solid solution electrolyte oxygen sensor. Oxygen partial pressures of 10 to the minus 7 power atm and 10 to the minus 8 power atm were obtained at the two facilities. These measurements are believed to represent nonequilibrium conditions. A.R.H.

N81-11456*# ECON, Inc., Princeton, N. J.
SATELLITE POWER SYSTEM SALVAGE AND DISPOSAL ALTERNATIVES Final Report
Nov. 1980 91 p refs
(Contract NAS8-33783)
(NASA-CR-3349; ECON-80-148-1) Avail: NTIS HC A05/MF A01 CSCL 10A

A wide range of salvage options for the SPS satellite, ranging from use in and beyond geosynchronous orbit to use in low Earth orbit in return and use on Earth are presented. The satellite can be used intact to provide power for various purposes, it can be cannibalized or it can be melted down to supply materials for space or ground based products. The use of SPS beyond its nominal lifetime provides value that can be deducted from the SPS capital investment cost. The present value of the salvage value of the SPS satellites, referenced to the system initial operation data, is on the order of five to ten percent of its on-orbit capital cost. (Given a 30 year satellite lifetime and a four percent discount rate, the theoretical maximum salvage value is 30.8 percent of the capital cost.) The SPS demonstration satellite is available some 30 years earlier than the first full scale SPS satellite and has a salvage value on the order of 80 percent of its on-orbit capital cost. In the event that it becomes desirable to dispose of either the demonstration of full scale SPS satellite, a number of disposal options is presented for which intact disposal costs are less than one percent of capital costs. T.M.

N81-11457*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
MINIMUM ENERGY TEST DIRECTION DESIGN IN THE CONTROL OF CRYOGENIC WIND TUNNELS Progress Report, period ending Jun. 1980
S. Balakrishma and G. L. Goglia Jun. 1980 56 p refs
(Grant NsG-1503)
(NASA-CR-163244) Avail: NTIS HC A04/MF A01 CSCL 10A

The advent of the cryogenic wind tunnel concept is attributable to the need for high Reynolds number flow in wind tunnels. The cryogenic wind tunnel concept consists of operating the test medium of a conventional tunnel at cryogenic temperatures down to 80 K. Nitrogen gas, cooled by injected liquid nitrogen, proves to be ideal for the cryogenic tunnel test medium because of its near perfect behavior in insentropic flow. Cryogenic operation of a wind tunnel results in reduced fan power consumption and no penalty in flow dynamic pressure. In a cryogenic tunnel, the flow parameters (Reynolds number, Mach number and flow dynamic pressure) can be independently controlled by separately controlling the tunnel flow variables: total temperature, test section mass flow, and the tunnel total pressure. The problem of closed-loop control of the tunnel total temperature, flow Mach number, and total pressure is addressed and reported. S.F.

N81-11458*# Raytheon Co., Wayland, Mass. Equipment Div.
SOLID STATE SPS MICROWAVE GENERATION AND TRANSMISSION STUDY. VOLUME 1: PHASE 2 Final Report
Owen E. Maynard Washington Nov. 1980 236 p refs
(Contract NAS8-33157)
(NASA-CR-3338; M-311; ER80-4074-1) Avail: NTIS HC A11/MF A01 CSCL 10A

The solid state sandwich concept for Solar Power Station (SPS) was investigated. The design effort concentrated on the spacetenna, but did include some system analysis for parametric comparison reasons. The study specifically included definition and math modeling of basic solid state microwave devices, an initial conceptual subsystems and system design, sidelobe control and system selection, an assessment of selected system concept and parametric solid state microwave power transmission system data relevant to the SPS concept. Although device efficiency was not a goal, the sensitivities to design of this efficiency were parametrically treated. Sidelobe control consisted of various single step tapers, multistep tapers, and Gaussian tapers. A preliminary assessment of a hybrid concept using tubes and solid state is also included. There is a considerable amount of thermal analysis provided with emphasis on sensitivities to waste heat radiator form factor, emissivity, absorptivity, amplifier efficiency, material and junction temperature. Author

N81-11459*# Rice Univ., Houston, Tex.
ELECTROSTATIC PROTECTION OF THE SOLAR POWER SATELLITE AND RECTENNA. PART 1: PROTECTION OF THE SOLAR POWER SATELLITE Final Report
Washington NASA Nov. 1980 36 p refs
(Contract NAS8-33023)
(NASA-CR-3344; M-308) Avail: NTIS HC A03/MF A01 CSCL 10A

Several features of the interactions of the Solar Power Satellite (SPS) with its space environment are examined theoretically. The voltages produced at various surfaces due to space plasmas and the plasma leakage currents through the kapton and sapphire solar cell blankets are calculated. At geosynchronous orbit, this parasitic power loss is only 0.7%, and is easily compensated by oversizing. At low Earth orbit, the power loss is potentially much larger (3%), and anomalous arcing is expected for the EOTV high voltage negative surfaces. Preliminary results of a three dimensional self consistent plasma and electric field computer program are presented, confirming the validity of the predictions made from the one dimensional models. Lastly, magnetic shielding of the satellite is considered to reduce the power drain and to protect the solar cells from energetic electron and plasma ion bombardment. It is concluded that minor modifications can allow the SPS to operate safely and efficiently in its space environment. Subsequent design changes will substantially alter the basic conclusions. L.F.M.

N81-11460# RCA Labs., Princeton, N. J.
LOW COST EPITAXIAL TECHNIQUES FOR SOLAR CELL FABRICATION Quarterly Technical Progress Report, 25 Mar. - 24 Jun. 1980
R. V. DAiello and P. H. Robinson Jul. 1980 34 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-0-8274-3; QTPR-3) Avail: NTIS HC A03/MF A01

The practical aspects of making epitaxial solar cells were emphasized by exploring the growth and fabrication of large area cells. A significant achievement was the attainment of efficiencies close to 10% with epitaxial cells of 10.8 cu cm area grown on the lowest grade silicon substrate under study. For larger areas 23.1 cu cm an efficiency of 7.0% was obtained. The use of low cost surface preparation techniques was successfully demonstrated for both epitaxial growth and the resultant solar cell properties. Some requirements on the subsequent application of AR coatings are pointed out. Work on the use of silane as an alternate gaseous silicon source was extended by exploring growth on upgraded metallurgical grade silicon substrates. The results show equivalent performance for cell structures grown in silane at 1000 C with those grown using dichlorosilane at 1100 to 1150 C. DOE

N81-11461# ECO, Inc., Cambridge, Mass.
ELECTROLYTES FOR HYDROCARBON AIR FUEL CELLS Interim Technical Report
M. Walsh, F. Walsh, D. N. Crouse, and R. S. Morris Apr. 1980 33 p refs
(Contract DAAK70-79-C-0165)
(AD-A089844) Avail: NTIS HC A03/MF A01 CSCL 10/2

The present research is directed towards obtaining an improved electrolyte for hydrocarbon-air fuel cells. No commercially available electrolyte appears to demonstrate promise. Two new electrolytes, difluoromethanediphosphonic acid and difluoromethanedisulfonic acid, have been synthesized and are being tested. The present status of the project and the outstanding problems are reviewed. GRA

N81-11462# Engelhard Minerals and Chemicals Corp., Edison, N. J. Industries Div.
PHOSPHORIC ACID FUEL CELL DEVELOPMENT Final Technical Report, Sep. 1977 - Nov. 1979
A. Kaufman and P. L. Terry Sep. 1980 103 p
(Contract DAAK70-77-C-0206; DA Proj. 1L7-63702-DG-11)
(AD-A090143) Avail: NTIS HC A05/MF A01 CSCL 10/2

Phosphoric acid fuel cells and fuel cell stacks were evaluated operating on simulated product gases from a methanol reformer. Three cell stack performance in a start-up/shut-down cycling mode was investigated. Improved matrix and electrode formulations were utilized later in the program, and these components accumulated a total of 8496 hours of testing and 268 shut-down cycles. GRA

N81-11463# Oak Ridge National Lab., Tenn. Energy Div.
RESEARCH ON NONECONOMIC FACTORS RELEVANT TO THE DIFFUSION OF SOLAR TOTAL ENERGY SYSTEMS
Linda G. Berry and Lois M. Bronfman Aug. 1980 78 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7297) Avail: NTIS HC A05/MF A01

The policy uses of some of the concepts and models found in diffusion of innovation literatures other than those of economics and marketing were reviewed and evaluated. The results of this review were applied to the specific case of a Solar Total Energy System (STES). The research effort had three parts. The first part was to identify and obtain an overview of the noneconomics social science literature relevant to the problem of forecasting and accelerating adoption rates. After the first part was completed and the principal research perspectives and researchers in the field were identified, a workshop of experts was organized to address the problem of predicting and accelerating diffusion rates for STESs. Finally, the results of the literature review and the workshop are summarized, and a number of approaches suggested by the diffusion literature are used to obtain an evaluation of the adoption potential of STES. DOE

N81-11464# California Univ., Berkeley. Lawrence Berkeley Lab.
OCEAN THERMAL ENERGY CONVERSION PRELIMINARY DATA REPORT FOR THE FEBRUARY 1978 GOTEC-03 CRUISE TO THE GULF OF MEXICO, MOBILE SITE
Jun. 1980 34 p refs
(Contract W-7405-eng-48)
(LBL-9438) Avail: NTIS HC A03/MF A01

Preliminary physical, chemical, and biological data obtained on the GOTEC-03 cruise in February 27 to March 3, 1978 to the Mobile Site near 29 deg N, 88 deg W are presented in tabular and graphic form. The physical and chemical data consists of salinities and dissolved oxygens derived from water samples and temperatures from XBT's. The biological data includes biomass indicators (chlorophyll a, phaeophytin, and adenosine triphosphate), and zooplankton samples. DOE

N81-11465# Aerospace Corp., Los Angeles, Calif. Energy and Resources Div.
SUMMARY OF SYSTEM DESIGNS FOR PHOTOVOLTAIC EXPERIMENTS AND RECOMMENDATIONS FOR FUTURE ACTIVITIES
R. B. Fling and B. Siegel Jul. 1980 56 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7069) Avail: NTIS HC A04/MF A01

The designs covered a wide range of applications, including office buildings, industrial plants, airports, schools, amusement parks, utility substations, institutional facilities, and remote stand

alone loads. The concentrator types included parabolic troughs, linear Fresnel, circular Fresnel, and cassegrain designs with geometric concentration ratios ranging from 20 to 400. One project selected gallium arsenide as a cell material and all but one of the remaining designs used single crystal silicon cells. Nine of the projects were selected for construction and evaluation. DOE

N81-11466# Spire Corp., Bedford, Mass.
AMORPHOUS SILICON SOLAR CELLS BY HYDROGEN IMPLANTATIONS Quarterly Report, 1 Jul. - 30 Sep. 1979
A. R. Kirkpatrick and A. A. Melas Jan. 1980 27 p refs
(Contract DE-AC03-79ET-23042)
(SAN-3042-3; QR-3) Avail: NTIS HC A03/MF A01

A large number of implantation matrices were evaluated and material investigations initiated. The usefulness of ion implantation in the amorphization and hydrogenation of devices was established. Indeed both of these processes can controllably and reproducibly be carried out. The amorphized material shows superior visible light absorption behavior compared to crystalline silicon. Hydrogenation with subsequent furnace annealing produces higher open circuit voltage, in selected devices, than the polycrystalline material. The use of infrared spectroscopy established the presence and type of silicon hydrogen bonding. DOE

N81-11467# Varian Associates, Palo Alto, Calif. Solid State Lab.
NEAR-TERM IMPLEMENTATION OF PRODUCTION COST REDUCTION FOR PHOTOVOLTAIC CONCENTRATOR ARRAY
Bruce R. Cairns Jul. 1980 78 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-7066) Avail: NTIS HC A05/MF A01

Progress on the development of a standardized process for fabricating GaAs/AlGaAs concentrator solar cells at a lower cost is reported. High quality GaAs ingots weighing 1.0 to 1.5 Kgm and 2.0 to 2.5 in. diameter were routinely grown. A high throughput liquid phase epitaxial reactor was completed and considerable process development work was performed to characterize growth parameters. Larger area organometallic growth of thin AlGaAs layers led to improved cell efficiencies for this material. An improved cell metallization structure and process was developed to give reliable low contact resistance, stable at temperatures of 400 C and above. The silicon nitride AR coating was also improved. Package development to obtain a packaged cell suitable for easy installation in an array is discussed. Completely packaged cells from liquid and organometallic epitaxial material gave efficiencies in the 18 to 20 percent range at 440 suns concentration. DOE

N81-11468# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
DEVELOPMENT OF HIGH EFFICIENCY SOLAR CELLS Final Technical Report, 23 Jan. 1978 - 2 Jan. 1979
D. L. Miller, Marshall J. Cohen, J. S. Harris, Jr., Joseph Loferski (Brown Univ.), Joseph Ballantyne (Cornell Univ.), Tarak Bhar (Howard Univ.), and Elias Stefanakos (North Carolina Agricultural and Technical State Univ.) Apr. 1979 184 p refs
(Contract ET-78-C-03-1712; EG-77-C-03-1712)
(SAN-1712-T1) Avail: NTIS HC A09/MF A01

Emphasis was on developing new polycrystal growth techniques, developing new analytical techniques to study grain boundaries, and fundamental studies of the physical mechanisms by which grain boundaries limit solar cell performance. Molecular beam epitaxy proved to be a very attractive technique for fundamental studies of both grain boundaries and unique device structures. Several high spatial resolution analytical techniques were developed and are providing information on the electrical properties of grain boundaries. Auger potential profiling provided the first experimental verification of the Fermi level pinning at a grain boundary. Cathodoconductivity, photovoltage, and photocurrent measurements with a scanning laser microscope provided data on minority carrier transport near grain boundaries. Transient capacitance and deep level transient spectroscopy measurements are yielding data on carrier lifetime, trap levels, and densities at grain boundaries. DOE

N81-11469# Hanford Engineering Development Lab., Richland, Wash.
CURRENT SOLAR CELL MEASUREMENT METHODS REVIEW AND EVALUATION
D. R. Green, T. E. Michaels, L. C. Olsen, and L. S. Price May 1980 159 p refs
(Contracts DE-AC14-76FF-02170; EY-77-C-01-8146; EY-76-C-14-2170)
(HEDL-TC-1548) Avail: NTIS HC A08/MF A01

Selected measurement methods commonly applied to solar cells are studied. Basic theoretical models are emphasized, and methods for determining important parameters are outlined. Methods are reviewed for measurement of resistivity, Hall effect, Seebeck effect, dark current voltage characteristics, illuminated current voltage characteristics, and spectral photoresponse. State of the art in each area is reviewed. DOE

N81-11470# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
ENVIRONMENTAL DATA FOR SITES IN THE NATIONAL SOLAR DATA NETWORK
Jul. 1980 265 p refs
(Contract DE-AC01-79CS-30027)
(SOLAR/0010-80/07) Avail: NTIS HC A12/MF A01

The environmental data for the National Solar Data Network (NSDN) are presented in the form of tables for each solar site. The solar sites are grouped into 12 zones, each of which consists of several adjacent states. The solar energy sites are in alphabetical sequence within each zone. The tables provide available meteorological data for reporting sites in the NSDN as follows: insolation; temperature; wind; and humidity. R.C.T.

N81-11471# Oak Ridge Associated Universities, Tenn. Inst. for Energy Analysis.
STOCHASTIC SUN: UNDERSTANDING THE INTERMITTENT RESOURCE
David A. Boyd Jun. 1980 49 p refs
(Contract DE-AC05-76OR-00033)
(ORAU/IEA-80-10(M)) Avail: NTIS HC A03/MF A01

The concept of the ideal system is introduced as a device for separating resource limits from system effects. The limitations on ideal system performance arising from intermittency are examined and the relationship between real systems and ideal systems is discussed. The general nature of the results of such an approach and of their implications for solar utilization is illustrated. DOE

N81-11472# Sandia Labs., Albuquerque, N. Mex. Energy Systems Analysis Div.
MECHANICAL ENERGY STORAGE FOR PHOTOVOLTAIC/WIND PROJECT Final Report
Bill C. Caskey and Harold E. Schildknecht Jun. 1980 66 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2259) Avail: NTIS HC A04/MF A01

The Solar Mechanical Energy Storage program is described. Contractor and system analyses results for residential flywheel energy storage systems are presented. Various phases of the program addressed small to intermediate applications of photovoltaic/wind energy storage using flywheels, compressed air, and low head, underground pumped hydro technologies. Sandia National Laboratories' recommendations for continued work in specific areas are included. DOE

N81-11473# California Univ., Berkeley. Lawrence Berkeley Lab.
SIMULATION MODEL FOR THE PERFORMANCE ANALYSIS OF ROOF POND SYSTEMS FOR HEATING AND COOLING
Mehdi Tavana, Ron Kammerud, Hashem Akbari (Abadan Inst. of Tech., Iran), and Tom Borgers (California State Univ., Arcata) Jun. 1980 8 p refs Presented at the Am. Sect. of the ISES Conf., Phoenix, Ariz., 2-6 Jun. 1980
(Contract W-7405-eng-48)
(LBL-9292-Rev; CONF-800604-34-Rev) Avail: NTIS HC A02/MF A01

A detailed computer model was developed for simulating the dynamic thermal behavior of roof pond systems. The model is composed of outer movable insulation, an optional evaporative

water layer over water bags on steel decking, and an inner movable insulation. A control stategy for the movable insulations which provides near optimum thermal performance is included in the model. An hourly thermal balance analysis of the system is performed using theoretical and/or empirical expressions to determine the heat transfer coefficients for each of the surfaces in the model. The model was used to study the effect on system thermal performance of (1) the R-value of both the top and bottom movable insulations, (2) the depth of the pond water, and (3) the depth of the evaporative layer. The heating and cooling potentials of the roof pond were also investigated in four climates. The model was developed for incorporating into the public domain building energy analysis computer program BLAST. DOE

N81-11474# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.

GEOTHERMAL ENERGY DEVELOPMENT IN THE EASTERN UNITED STATES. GEOTHERMAL SPACE HEATING: PITTSVILLE MIDDLE/ELEMENTARY SCHOOL, PITTSVILLE, MARYLAND

Roy VonBriesen and Kwang Yu Jun. 1980 33 p
(Contracts EX-76-A-36-1008; DE-AI01-79ET-27025)
(JHU/APL-QM-80-101) Avail: NTIS HC A03/MF A01

A technical evaluation was made to determine whether geothermal energy obtained from a well could be used to space heat the new school building being constructed as well as the existing elementary wing of the Pittsville School. The first part deals with space heating the new school building only; the second part pertains to space heating the new school building together with the new existing wing. An addendum was added for new well and production pump costs. DOE

N81-11475# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.

ENERGY TECHNOLOGY PROGRAMS: PROGRAM SUMMARIES FOR 1979

B. Manowitz and T. E. OHare Dec. 1979 48 p
(Contract DE-AC02-76CH-00016)
(BNL-51167) Avail: NTIS HC A03/MF A01

The Energy Technology Programs in the Brookhaven National Laboratory Department of Energy and Environment cover a broad range of activities, namely: electrochemical research, chemical energy storage, chemical heat pumps, solar technology, fossil technology, catalytic systems development, space conditioning technology, and technical support/program management. Summaries of the individual tasks associated with these activities along with publications, significant accomplishments, and program funding levels are presented. DOE

N81-11476# Department of Energy, Washington, D. C. Office of Basic Energy Sciences.

BASIC RESEARCH NEEDS IN SEVEN ENERGY RELATED TECHNOLOGIES, CONSERVATION, CONVERSION, TRANSMISSION AND STORAGE, ENVIRONMENTAL FISSIONS, FOSSIL, GEOTHERMAL, AND SOLAR

Jul. 1980 209 p refs
(DOE/ER-0060) Avail: NTIS HC A10/MF A01

Seven studies performed by seven groups at seven national laboratories are presented. The laboratories were selected because of their assigned lead roles in research pertaining to the respective technologies. Researchers were requested to solicit views of other workers in the fields. DOE

N81-11477# Gilbert/Commonwealth, Reading, Pa.

FEASIBILITY STUDY: FUEL CELL COGENERATION IN A WATER POLLUTION CONTROL FACILITY, VOLUME 2 Final Report

Feb. 1980 164 p refs
(Contract DE-AC03-78ET-12431)
(DOE/ET-12431/T1-Vol-2) Avail: NTIS HC A08/MF A01

A conceptual design study was conducted to investigate the technical and economic feasibility of a cogeneration fuel cell power plant operating in a large water pollution control facility. The fuel cell power plant would use methane rich digester gas from the water pollution control facility as a fuel feedstock to provide electrical and thermal energy. Several design configurations were evaluated. These configurations were comprised of combinations of options for locating the fuel cell power plant at the site, electrically connecting it with the water pollution control facility, using the rejected power plant heat, supplying fuel to the power plant, and for ownership and operation. A configuration was selected which met institutional/regulatory constraints and provided a net cost savings to the industry and the electric utility. DOE

N81-11478# United Technologies Corp., South Windsor, Conn.

RELATION BETWEEN COMPONENT TECHNICAL PARAMETERS AND FUEL CELL POWER PLANT CHARACTERISTICS Final Technical Report, 15-30 Sep. 1979

Alexander Levy and Leslie Van Dine 1979 76 p
(Contracts DE-AC03-78ET-12445; ET-78-C-03-2111)
(DOE-ET-12445/T1; FCR-1737) Avail: NTIS HC A05/MF A01

The impact of applied technology improvements on fuel cell power plant operational and cost characteristics is determined. The results of this evaluation are intended to identify to DOE those areas which will provide the most significant payoff for long range research and development activities. The phosphoric acid fuel cell is emphasized and small multikilowatt on-site power plants as well as large multimegawatt systems intended for dispersed utility application are investigated. In addition, since complete power plants are considered, the potential improvements in major ancillary subsystems, such as fuel processing and power conditioning, are evaluated in terms of their impact on the entire system and its potential for meeting the requirements of various applications is presented and discussed. DOE

N81-11479# State Univ. of New York at Stony Brook. Inst. for Energy Research.

NEW YORK STATE ENERGY-ANALYTIC INFORMATION SYSTEM: FIRST-STAGE IMPLEMENTATION

J. Allentuck, Owen Carroll, Linda Fiore, Niel Katz, Robert Malone, Robert Nathans, Michael Owen, Drazen Prelec, Robert Raymond, Ann Reisman et al Sep. 1979 307 p refs Prepared in cooperation with Brookhaven National Lab.
(Contract DE-AC02-76CH-00016)
(BNL-51138) Avail: NTIS HC A14/MF A01

The design of an energy information/analytic system for New York State, the data for a base year, 1976, and projections of these data are presented. At the county level, 1976 energy supply demand data and electric generating plant data are provided as well. Data base management is based on System 2000. Three computerized models provide the system's basic analytic capacity. The Brookhaven Energy System Network Simulator provides an integrating framework while a price response model and a weather sensitive energy demand model furnished a short term energy response estimation capability. The operation of these computerized models is described. DOE

N81-11480# Science Applications, Inc., Palo Alto, Calif.

USING STATISTICALLY DESIGNED EXPERIMENTS IN DEVELOPMENT OF ADVANCED BATTERY SYSTEMS

S. L. Basin and William C. Spindler (Electric Power Research Inst.) Feb. 1980 126 p refs
(EPRI-EM-1346) Avail: NTIS HC A07/MF A01

It is shown that the determination of significant effects resulting from planned variations in experimental conditions can be implemented easily in two level factorial designs and in calculations emphasizing analysis of variance techniques. Actual case studies and discussions of selected reports on battery projects are used as examples. These also illustrate the significant additional advantages of statistically designed experimental planning and analysis compared to one of a kind, uncontrolled experiments. A typical example of the latter approach is examined, in which the lack of a statistical plan is shown to have resulted in excessive work, drawing wrong conclusions, and having no estimates of the uncertainties in the data. The material applies to many other fields experimentation, as in studies of factors that may affect the outcome of industrial procedures. It should be most useful to experimentalists who recognize the need for better results than obtainable from ordinary one at a time and baseline test methods. DOE

N81-11481# Battelle Columbus Labs., Ohio.

DEVELOPMENT OF ELECTROCHEMICAL PHOTOVOLTAIC

CELLS Technical Progress Report, 1 Nov. 1979 - 31 Jan. 1980
H. J. Byker, R. E. Schwerzel, V. E. Wood, A. E. Austin, and E. W. Brooman 7 Mar. 1980 23 p refs
(Contract EG-77-C-01-4042)
(DSE-4042-T24; TPR-3) Avail: NTIS HC A02/MF A01

The development of stable, efficient, electrochemical photovoltaic cells based on silicon and gallium arsenide in nonaqueous electrolyte systems was investigated. The effect of surface condition of silicon electrodes on electrochemical and physical characteristics was studied. An electrode-supporting electrolyte interaction in acetonitrile was identified which leads to etching of the surface. Improved performance can result, which has practical significance. Gallium arsenide electrodes were electrochemically characterized in cells containing propylene carbonate with a ferrocene/ferricenium redox additive. Degradation of the ferricenium salt under illumination was investigated. Other redox couples studied did not give promising results. Long term stability experiments were deferred while a better understanding of electrode behavior is being obtained. DOE

N81-11482# *Los Alamos Scientific Lab., N. Mex. Solar Energy Group.*
OVERVIEW OF THE US PROGRAM FOR NONCONVECTING SOLAR PONDS
D. A. Neeper 1980 7 p refs Presented at the Nonconvecting Solar Pond Workshop, Washington, D.C., 30-31 Jul. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2134; CONF-800757-2) Avail: NTIS HC A02/MF A01

A brief history of research on solar ponds in the US is given. LASL's role in solar pond development is reviewed, and suggestions for future solar pond research are given. DOE

N81-11483# JBF Scientific Corp., Wilmington, Mass.
WIND ENERGY SYSTEMS APPLICATION TO REGIONAL UTILITIES
Sep. 1979 339 p
(Contracts DE-AC01-76ET-20063; EX-76-C-01-2438)
(DOE/ET-20063-T1/Vol-2) Avail: NTIS HC A15/MF A01

The computer programs used to analyze the economic impact of wind energy conversion systems (WECS) on a utility are described. The methodology requires extrapolating both historical utility load data and historical wind power into a year of analysis; calculating the total amount of funds made available in that year, as a result of the inclusion of wind power in the utility mix; and then estimating the present value of the total funds made available to the utility over the life of the WECS. Wherever possible, a typical input/output file is shown. DOE

N81-11484# Sandia Labs., Albuquerque, N. Mex. Guidance and Control Div.
DEVELOPMENT OF A MICROPROCESSOR-BASED SUN-TRACKING SYSTEM FOR SOLAR COLLECTORS
Stewart M. Kohler and Jeffrey L. Wilcoxen Apr. 1980 23 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2163) Avail: NTIS HC A02/MF A01

The development of a prototype Sun-tracking system and the tests performed on it on an east-west trough solar collector array are described. The system includes a controller built around an RCA1802 microprocessor, a digital shaft encoder, and a heat flux sensor. The heat flux sensor consists of a fine resistance wire wrapped around the receiver tube. The wire is used to correct errors in calculated tracking angles arising from reflector imperfections and misalignments. DOE

N81-11485# Sandia Labs., Albuquerque, N. Mex. Component and Subsystem Development Div.
FLUID TEMPERATURE CONTROL FOR PARABOLIC TROUGH SOLAR COLLECTORS
Rudolph Schindwolf Jun. 1980 35 p refs
(Contract DE-AC04-76DP-00789)
(SAND-79-2006) Avail: NTIS HC A03/MF A01

Computer simulation studies of temperature control techniques for the heat transfer fluid in parabolic trough solar collector fields are discussed. In particular, the temperature control requirements associated with thermal electric power generation or cogeneration systems are addressed. Computer models representing the fluid temperature dynamics of the collectors and interconnecting piping were developed and integrated with dynamic models of control elements to obtain a simulation of a closed loop control system. A specific control configuration was chosen consisting of a flow control valve and one or more temperature sensors to control the flow in each row of collectors. Various control algorithms were evaluated for stability and static errors, and time responses to startup transients and to partial and full collector cloud shadowing transients were obtained. The results indicate that the temperature control requirements can be satisfied using readily available components. DOE

N81-11486# Zia Associates, Inc., Boulder, Colo.
ROCK BED STORAGE WITH HEAT PUMP Final Report
H. E. Remmers and G. L. Mills May 1979 170 p refs
(Contract EM-78-C-02-4704)
(COO-4704-3) Avail: NTIS HC A08/MF A01

The operating characteristics of off the shelf components of heat pump/rock bed storage systems were studied, and the results were used to formulate configurations of representative systems. These systems were modeled and subsequently analyzed using the TRNSYS computer program a life cycle cost analysis program called LCCA. A detailed load model of a baseline house was formulated as part of the TRNSYS analysis. Results of the analysis involved the development of a technique to confine the range of heat pump/rock bed storage systems to those systems which are economical for a specific location and set of economic conditions. Additionally, the results included a comparison of the detailed load model with simple UA models such as the ASHRAE bin method. Several modifications and additions were made to the TRNSYS and LCCA computer programs. DOE

N81-11487# *Los Alamos Scientific Lab., N. Mex. Solar Energy Group.*
RESEARCH AND DEVELOPMENT TO SUPPORT COMMERCIALIZATION IN SOLAR PONDS
Kenneth A. Meyer 1980 8 p Presented at the Nonconvecting Solar Pond Workshop, Washington, D.C., 30-31 Jul. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2123; CONF-800757-1) Avail: NTIS HC A02/MF A01

An indepth analytical, numerical, and experimental program leading to the understanding of solar pond hydrodynamics is presented. The practical problems of water clarity, heat extraction, maintenance, and thermal loses are quantified. The need for a coordinated research and development program with the necessary long term continuity to accomplish these goals is emphasized. DOE

N81-11488# *Martin Marietta Corp., Denver, Colo.*
SOLAR CENTRAL RECEIVER HYBRID POWER SYSTEM, PHASE 1. VOLUME 2: CONCEPTUAL DESIGN Final Technical Report, Oct. 1978 - Aug. 1979
Sep. 1979 511 p refs
(Contract ET-78-C-03-2234)
(DOE/ET-21038/1-Vol-2) Avail: NTIS HC A22/MF A01

A hybrid power system design that produces minimum cost electric power, minimizes the capital investment and operating cost, permits capacity displacement, and achieves utility acceptance for market penetration is proposed. The concept combines the alternate central receiver power system design and a high temperature salt primary heat transfer fluid and thermal storage media system with a fossil fired nonsolar energy source. Twenty-two utilities were selected within nine regions of the country. Both written and verbal correspondence was used to assess solar hybrid power plants with respect to the utilities' future requirements and plans. DOE

N81-11489# Institute of Gas Technology, Chicago, Ill.
ELECTROCHEMICAL PHOTOVOLTAIC CELLS Quarterly Technical Progress Report, 15 Oct. 1979 - 15 Jan. 1980
Peter C. P. Ang, Robert J. Remick, and Anthony F. Sammells
Mar. 1980 39 p refs
(Contract EG-77-C-01-4042)
(DSE-4042-T26) Avail: NTIS HC A03/MF A01

Liquid junction devices based upon the semiconductors

MoSe2, GaAs, and CdSe were evaluated. Lifetime testing of MoSe2 and MoS2 materials in acidic halogen electrolytes at constant current densities of 5 mA/sq cm showed excellent stability. For MoSe2 single crystals in the electrolyte 1M HBr + 1M Br2 short circuit currents of 63 mA/sq cm were achieved with a power conversion efficiency of 6.7% for 200 mW/sq cm xenon light illumination. Transient potentiostatic measurements made on MoSe2 in this electrolyte indicated little diffusion control, with exchange currents being of the order of 1 to 10 mA/sq cm. Good photoresponse of MoS2 has been observed in 1M HBr + 1M Br2. The performance of the natural crystal is comparable to the performance of a single crystal MoS2 in this electrolyte. CdSe thermally evaporated onto porous titanium gave efficiencies of about 4% with 100 mW/sq cm xenon illumination. Experimental work was initiated on the dye sensitization of Fe2O3 and TiO2 materials. Of the twelve dyes evaluated, little enhancement of the photoresponse of these materials was noted. DOE

N81-11490# Midwest Research Inst., Golden, Colo. Solar Thermal Engineering Development Branch.

PRELIMINARY OPERATIONAL RESULTS OF THE LOW TEMPERATURE SOLAR INDUSTRIAL PROCESS HEAT FIELD TESTS

Charles F. Kutscher and Roger L. Davenport Jun. 1980 40 p refs

(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)

(SERI/TR-632-385) Avail: NTIS HC A03/MF A01

Six solar industrial process heat field tests have been in operation for a year or more, three are hot water systems and three are hot air systems. All are low temperature projects (process heat at temperatures below 212 F). Performance results gathered by each contractor's data acquisition system are presented and project costs and problems encountered are summarized. Flat plate, evaluated tube, and line focus collectors are all represented with collector array areas ranging from 2500 to 21,000 sq ft. Collector array efficiencies ranged form 12% to 36% with net system efficiencies from 8% to 33%. Low efficiencies are attributable in some cases to high thermal losses and, for the two projects using air collectors, are due in part to high parasitic power consumptions. Problems included industrial effluents on collectors, glazing and absorber surface failures, excessive thermal losses, freezing and overheating, control problems, and data acquisition system failure. With design and data acquisition costs excluded, costs of the projects ranged from $25/sq ft to $87/sq ft and $499/(MBtu/yr) to $1537/(MBtu/yr). DOE

N81-11491# California Univ., Berkeley. Lawrence Berkeley Lab.

IMPORTANCE OF THE SPECIFIC HEAT ANOMALY IN THE DESIGN OF BINARY RANKINE CYCLE POWER PLANTS

William L. Pope, Padraic A. Doyle, Robert L. Fulton, and Lenard F. Silvester May 1980 5 p refs Presented at the Geothermal Resource Council Ann. Meeting, Salt Lake City, 9-11 Sep. 1980

(Contract W-7405-eng-48)

(LBL-10974; CONF-800920-5) Avail: NTIS HC A02/MF A01

The transposed critical temperature (TPCT) is shown to be an extremely important thermodynamic property in the selection of working fluids and turbine states for geothermal power plants operating on a closed organic (binary) Rankine cycle. When the optimum working fluid composition and process states are determined for specified source and sink conditions, turbine inlet states consistently lie adjacent to the working fluids TPCT line for all resource temperatures, constraints, and cost and efficiency factors investigated. DOE

N81-11492# AeroVironment, Inc., Pasadena, Calif. Aerosciences Group.

DEFINITIVE GENERIC STUDY FOR THE EFFECT OF HIGH LIFT AIRFOILS ON WIND TURBINE EFFECTIVENESS, EXECUTIVE SUMMARY Final Report

Peter B. S. Lissaman, Robert E. Wilson, R. W. Thresher, and Stel N. Walker May 1979 93 p refs

(Contract EG-77-C-01-4042)

(SERI/TR-98003-2) Avail: NTIS HC A05/MF A01

The effect of high lift airfoils on the cost effectiveness of HAWT and VAWT (horizontal and vertical axis wind turbine) machines is studied. The scope involved first studying modern two dimensional airfoils, and developing a generalized formulation for their performance in terms of lift, drag, and thickness at appropriate Reynolds numbers. Single element, multi-element, symmetrical, extra thick airfoils and jet flap airfoils were analyzed. The jet flap airfoils were considered to be unacceptable because of excessive power requirements. Then the effect of using the above airfoils on the rotors of a variety of wind turbines was made. Qualitative representation of the type of airfoils studied is given. DOE

N81-11493# Burns and Roe, Inc., Woodbury, N. Y.

PRELIMINARY ASSESSMENT OF ALTERNATIVE PFBC POWER PLANT SYSTEMS Final Report

J. Wysocki and R. Rogali Jul. 1980 114 p refs

(EPRI Proj. 1645-2)

(EPRI-CS-1451) Avail: NTIS HC A06/MF A01

Design and economic comparisons of the following nominal 1000 MWe pressurized fluidized bed combustion (PFBC) power plants are presented for both eastern and western coal: Curtiss-Wright PFBC power plants with an air-cooled design; General Electric RFBC power plants with a steam-cooled design; and AEP/Stal-Laval PFBC power plants with a steam-cooled design. In addition, reference pulverized coal-fired (PCF) power plants are included for comparison purposes. The results of the analysis indicate: (1) the steam-cooled PFBC designs show potential savings of 10% and 11% over PCF plants for eastern and western coal, respectively, in terms of busbar power cost; (2) the air-cooled PFBC designs show potential savings of 1% and 2% over PCF plants for eastern and western coal, respectively, in terms of busbar power cost. DOE

N81-11494# Products Research and Chemical Corp., Glendale, Calif.

DEVELOPMENT OF 400 F SEALANTS FOR FLAT PLATE SOLAR COLLECTOR CONSTRUCTION AND INSTALLATION *Final Report, 1 Oct. 1978 - 30 Sep. 1979*

Lester Morris and R. J. Schubert Mar. 1980 71 p

(Contract DE-AC04-78CS-35303)

(DOE/CS-35303/T1) Avail: NTIS HC A04/MF A01

Twenty candidate sealants representing ten different polymer types were evaluated as potential solar collector sealants. Polymer types tested included epichlorohydrin rubber, EPDM rubber, silicone, polysulfide, acrylate rubber, and a fluoroelastomer. Initial screening of sealants consisted of measuring high temperature stability and adhesion retention. Several sealant compositions exhibited satisfactory performance in these tests and were selected for further evaluation. These materials were based on an EPDM rubber, a Viton fluoroelastomer, and silicone polymers. Further testing of these candidate materials included determination of adhesion retention under uv/water/heat conditions, fogging temperature, low temperature flexibility, and physical properties. Four silicone-based materials appeared to be suitable candidates for sealing solar collectors. DOE

N81-11495# Oregon Inst. of Tech., Klamath Falls. Geo-Heat Utilization Center.

ALASKA: A GUIDE TO GEOTHERMAL ENERGY DEVELOPMENT

Neil Basescu, R. Gordon Bloomquist, Charles Higbee, Debra Justus, and Stuart Simpson Jun. 1980 125 p refs

(Contracts DE-AS06-77ET-28476; EY-77-C-06-1066)

(DOE/ET-28476/T2) Avail: NTIS HC A06/MF A01

A brief overview is given of the geological characteristics of each region of the state as they relate to potential geothermal development. Those exploration methods which can lead to the siting of a deep exploration well are described. Requirements and techniques needed for drilling deeper higher temperature exploration and production wells are presented. Electrical generation, direct utilization, and indirect utilization are reviewed. Economic factors of direct use projects are presented. A general guide to the regulatory framework affecting geothermal energy development is provided. The general steps necessary to gain access to explore, develop, distribute, and use geothermal resources are outlined. DOE

N81-11496# Oak Ridge National Lab., Tenn.
FOSSIL ENERGY MATERIALS NEEDS ASSESSMENT
R. T. King, comp. and R. R. Judkins, comp. Jul. 1980 144 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7232) Avail: NTIS HC A07/MF A01

An assessment of needs for materials of construction for fossil energy systems was prepared by Oak Ridge National Laboratories staff members who conducted a literature search and interviewed various individuals and organizations that are active in the area of fossil energy technology. Critical materials problems associated with fossil energy systems are identified. Background information relative to the various technologies is given and materials research needed to enhance the viability and improve the economics of fossil energy processes is discussed. The assessment is presented on the basis of materials-related disciplines that impact fossil energy material development. These disciplines include the design-materials interface, materials fabrication technology, corrosion and materials compatibility, wear phenomena, ceramic materials, and nondestructive testing. DOE

N81-11497# Toledo Univ., Ohio. College of Engineering.
PERFORMANCE IMPROVEMENT OF A SOLAR HEATING SYSTEM UTILIZING OFF-PEAK ELECTRIC AUXILIARY
Adel H. Eltimsahy Jun. 1980 101 p refs
(Contract DE-FG02-79R5-10140)
(DOE/R5-10140/T1) Avail: NTIS HC A06/MF A01

The design and construction of a heat pump system suitable for incorporating in a space solar heating system utilizing off-peak storage from the electric utility are described. The performance of the system was evaluated. The refrigerating capacity, heating capacity and compressor horsepower for a heat pump system using a piston type compressor were determined. The heat pump design was matched with the existing University of Toledo solar house heating system. The refrigerant is Freon-12 working between a condensing temperature of up to 172 F and evaporator temperature between 0 F and 75 F. The heat pump was then installed. Performance indices for the heat pump and the heating system in general are defined and generated by the on-line computer monitoring system for the 1979/80 heating season operation. DOE

N81-11498# EIC, Inc., Newton, Mass.
ANALYSIS OF ADVANCED THERMAL STORAGE SUBSYSTEMS FOR SOLAR HEATING AND COOLING Final Report, 1 Oct. 1977 - 30 Sep. 1978
P. OD. Offenhartz, J. M. Marston, and J. I. Watts Nov. 1979 198 p refs
(Contract EG-77-C-02-4483)
(COO-4483-F) Avail: NTIS HC A09/MF A01

Computer models for heating, cooling, and advanced thermal storage subsystems were developed in TRNSYS-compatible form. Simplified models for solar collection and building loads were written, together with routines that simulate a variety of space conditioning and advanced storage devices. Simulations using various storage concepts were carried out for four applications: (1) space and domestic hot water heating; (2) solar assisted heat pumping; (3) absorption air conditioning; and (4) thermally activated heat pumping. Overall performance differences traceable to the performance of a storage unit were generally small. The H2SO4/H2O storage system behaves in a fashion remarkably similar to water tank storage. Collector temperatures (and efficiencies) were nearly identical. Over the same temperature range, the H2/SO4/H2O system offers a factor of four advantage in volume, which may be offset in some climates by the requirement for a heat source at or above 5 C. DOE

N81-11499# Pennsylvania State Univ., University Park. . Dept. of Architectural Engineering.
EVALUATION OF THE SOLAR BUILDING, ALBUQUERQUE, NEW MEXICO Final Report, Apr. 1974 - Sep. 1978
Stanley F. Gilman Dec. 1979 76 p refs
(Contract EY-76-S-02-2704)
(COO-2704-22) Avail: NTIS HC A05/MF A01

During portions of the 1974-1975 and 1975-1976 winter heating seasons, a field evaluation was made of a solar-assisted heat pump heating system in a small commercial office building in Albuquerque, N.M. The system was comprised of one main water-to-water heat pump and five small water-to-air heat pumps. The liquid-type solar collector array had an area equivalent to about 10% of the building floor area. Other than the ethylene glycol/water solution circulated through the solar collector array, water was used in all parts of the system, including three thermal energy storage tanks. The work done on this project over the period of the contract is summarized and pertinent information concerning the building, the solar-assisted heat pump system, data acquisition aspects, results, and conclusions are included. DOE

N81-11500# Exxon Research and Engineering Co., Linden, N.J. Government Research Labs.
ALTERNATIVE ENERGY SOURCES FOR NON-HIGHWAY TRANSPORTATION, APPENDICES
E. N. Cart, Jr., ed. Jun. 1980 560 p
(Contract DE-AC05-77CS-05438)
(DOE/CS-05438/T1-Vol-3) Avail: NTIS HC A24/MF A01

A planning study was made for DOE on alternate fuels for nonhighway transportation (aircraft, rail, marine, and pipeline). DOE is provided with a recommendation of what alternate fuels may be of interest to nonhighway transportation users from now through 2025 and the research and development needed to allow nonpetroleum derived fuels to be used in nonhighway transportation. DOE

N81-11501# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
RESIDENTIAL VENTILATION WITH HEAT RECOVERY: IMPROVING INDOOR AIR QUALITY AND SAVING ENERGY
G. D. Roseme, J. V. Berk, M. L. Boegel, H. I. Halsey, C. D. Hollowell, A. H. Rosenfeld, and I. Turiel May 1980 30 p refs Presented at the ASHRAE/DOE Conf. on Thermal Performance of the Exterior Envelopes of Bldgs. Orlando, Fla., 3-5 Dec. 1979 Submitted for publication
(Contract W-7405-Eng-48)
(LBL-9749; CONF-791233-4; EEB-Vent-80-10) Avail: NTIS HC A03/MF A01

Residential air quality measurements were made and the use of mechanical ventilation systems with air-to-air heat exchangers is discussed as a promising means of pollutant control. A particular advantage of this control strategy is that the heat exchanger permits recovery of a large portion of the heat that would normally be lost in a simple exhaust ventilation system, and therefore maintains the energy efficiency of the house. An economic analysis is presented showing that installation of these systems in newly constructed homes is cost effective in most regions of the country. DOE

N81-11502# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
NEW MEASUREMENT STRATEGY FOR IN SITU TESTING OF WALL THERMAL PERFORMANCE
P. E. Condon, W. L. Carroll, and R. C. Sonderegger Jun. 1980 42 p refs Presented at the ASHRAE/DOE Conf. on Thermal Performance of the Exterior Envelopes of Bldg., Orlando, Fla., 3-5 Dec. 1979
(Contract W-7405-eng-48)
(LBL-8822; EEB-ENG-79-3; CONF-791233-6) Avail: NTIS HC A03/MF A01

A new device is proposed for measuring the thermal resistance and the dynamic thermal response of building walls in either the laboratory or the field. The primary departures from past approaches are the control of the time dependent surface heat fluxes on the specimen and the determination of the surface temperatures as dependent variables. The performance characteristics of the device are analyzed by the use of complex thermal admittance. A prototype is being developed based on this analysis. The apparatus is portable and has sophisticated on-line computer control and data analysis through the use of a microprocessor. DOE

N81-11503# California Univ., Berkeley. Lawrence Berkeley Lab.
ENERGY STORAGE IN AQUIFERS: A SURVEY OF RECENT THEORETICAL STUDIES
Chin Fu Tsang and Johan Claeson Mar. 1980 9 p refs

Presented at the Rockstore 80 Conf., Stockholm, 23-29 Jun. 1980 Prepared in cooperation with Lund Univ., Sweden
(Contract W-7405-eng-48)
(LBL-11059; CONF-8006102-1) Avail: NTIS HC A02/MF A01

Theoretical efforts in aquifer storage research and the impact their results may have on field projects are reviewed. Semianalytic studies, numerical modeling studies, and site specific studies are examined. DOE

N81-11504# Illinois Univ., Urbana. Dept. of Ceramic Engineering.
FERROELECTRIC CERAMICS FOR DIELECTRIC POWER CONVERSION Annual Report, 1 Mar. 1979 - 30 Apr. 1980
D. A. Payne and P. C. Held May 1980 46 p refs
(Contract DE-AS02-78ER-04679)
(DOE/ER-04679/3) Avail: NTIS HC A03/MF A01

Materials expected to have useful Curie temperatures, resistivities, coercive fields, and Devonshire coefficients are assessed including PZT (lead-zirconia-titania system), Bi(Na,K) Ti2O6, rare earth titanoniobates, other tantalates and niobates, and thin films. Graphs are given for spontaneous polarization as a function of composition, temperature dependence of spontaneous polarization and coercive field for modified PSZT dielectrics, temperature dependence of electric resistivity for modified PSZT dielectrics, and X-ray diffraction data. Materials forming and processing techniques are briefly described. DOE

N81-11505# Tennessee Univ., Tullahoma. Energy Conversion Div.
INTERELECTRODE INSULATOR DEVELOPMENT FOR THE UTSI MHD GENERATOR
M. K. White, M. S. Beaton, and C. W. Long Oct. 1979 37 p refs
(Contract DE-AC02-79ET-10815)
(DOE/ET-10815/T1; TR-7.6.2-79-01) Avail: NTIS HC A03/MF A01

Commercially available insulating materials that are easily workable, were used to enhance thermal conductivity and reduce moisture absorption and gas permeability. In two series of tests on numerous insulator systems under actual MHD run conditions, the best results were indicated by a woven leached silica cloth (Refrasil) coated with a commercial boron nitride slurry. Insulators made of solid plate boron nitride and also of boron nitride strips backed up with a gasketing material also gave promising performance. Results are presented and discussed. DOE

N81-11506# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
EFFECTS OF ATMOSPHERIC VARIABILITY ON ENERGY UTILIZATION AND CONSERVATION Final Report, 1 Jan. - 31 Dec. 1979
Elmar R. Reiter, C. C. Burns, H. Cochrane, G. R. Johnson, H. Leong, J. McKean, J. D. Sheaffer, A. M. Starr, and J. Webber Apr. 1980 113 p refs
(Contract DE-AS02-76EV-01340)
(COO-1340-69) Avail: NTIS HC A06/MF A01

An interdisciplinary approach towards a detailed assessment of energy consumption in urban space heating and cooling is presented in terms of measurement and modeling results. Modeling efforts concentrated on the city of Minneapolis, MN, using data from the winter seasons 1977/78 and 1978/79. Mean absolute daily errors of gas consumption estimated by the physical model applied to Minneapolis are 6.26% when compared to actual energy usage for the period 12/1/77 to 2/28/78. The mean daily absolute errors for the statistical reference model for the same period were 5.54%. Modeling of the energy consumption required detailed input of meteorological parameters from a special network of stations. As a spin-off, an assessment was obtained of the effects of anthropogenic heat on urban heat island generation under various synoptic conditions. A detailed building census, comprised of 105,722 heated structures, was obtained. DOE

N81-11507# Stein (Richard G.) and Associates, New York.
HANDBOOK OF ENERGY USE FOR BUILDING CONSTRUCTION
Richard G. Stein, C. Stein, M. Buckley, and M. Green Mar. 1980 211 p
(Contract DE-AC02-79CS-20220)
(DOE/CS-20220/1) Avail: NTIS HC A10/MF A01

The construction industry accounts for over 11.14% of the total energy consumed in the US annually. This represents the equivalent energy value of 1 1/4 billion barrels of oil. Within the construction industry, new building construction accounts for 5.19% of national annual energy consumption. The remaining 5.95% is distributed among new nonbuilding construction (highways, railroads, dams, bridges, etc.), building maintenance construction, and nonbuilding maintenance construction. Emphasis is given to new building construction; however, some information for the other parts of the construction industry is also included. Building designers are provided with information to determine the energy required for buildings construction and to evaluate the energy required for alternative materials, assemblies, and methods. It is also applicable to large-scale planning and policy determination in that it provides the means to estimate the energy required to carry out major building programs. DOE

N81-11508# Radian Corp., Austin, Tex.
ENERGY CONSERVATION IN DISTILLATION: A TECHNOLOGY APPLICATIONS MANUAL
May 1980 54 p refs
(Contract W-31-109-eng-38)
(DOE/CS-4431/T2) Avail: NTIS HC A04/MF A01

Distillation is the most widely practiced technique for separating mixtures of chemical species, but it is an energy intensive process. A 10 percent reduction in distillation energy consumption would effect a significant savings. On a national basis, this would be an annual savings of 200 trillion Btu, or the equivalent of 36.5 million barrels of oil per year. Technology to achieve these savings in distillation energy is available and measures are presented to assist process engineers in technical and economic analysis of the energy conservation measures most suitable for particular distillation applications. The manual catalogs all of the energy conservation options applicable to distillation and the options by the investment required; describes in detail the options having a significant potential to reduce distillation energy requirements economically; provides guidelines that will allow the plant engineer to quickly screen each option for his application; and provides short cut calculation procedures for use in a preliminary economic analysis of promising options. DOE

N81-11509# Poly Solar, Inc., Garland, Tex.
THIN-FILM POLYCRYSTALLINE SILICON SOLAR CELLS Technical Progress Report, 15 Apr. - 15 Jul. 1980
Jul. 1980 30 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-9192-1-T1; TPR-1) Avail: NTIS HC A03/MF A01

Efforts during the past quarter were directed to the purification of metallurgical silicon, the preparation of substrates, and the fabrication and characterization of solar cells. The partial purification of metallurgical silicon by extraction with aqua regia was investigated in detail, and the resulting silicon was analyzed by the atomic absorption technique. The unidirectional solidification of aqua regia-extracted metallurgical silicon on graphite was used for the preparation of substrates, and the impurity distribution in the substrate was also determined. Large area (greater than 30 sq cm) solar cells were prepared from aqua regia-extracted metallurgical silicon substrates by the thermal reduction of trichlorosilane containing appropriate dopants. Chemically deposited tin-dioxide films were used as antireflection coatings. Solar cells with AM1 efficiencies of about 8.5% were obtained. DOE

N81-11510# Westinghouse Research and Development Center, Pittsburgh, Pa. Materials Chemistry Dept.
LOW-COST SUBSTRATES FOR POLYCRYSTALLINE SILICON SOLAR CELLS BY ELECTRODEPOSITION PROCESSES Quarterly Progress Report, 1 Jan. - 31 Mar. 1980
W. R. Gass, I. E. Kanter, and R. E. Witkowski Jun. 1980 43 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/PR-8119-2-T2; QPR-2) Avail: NTIS HC A03/MF A01

Studies had begun to evaluate the technical feasibility for

producing thin film polycrystalline silicon sheet by molten salt electrolytic plating techniques. Purified metallurgical grade silicon and silica will be investigated as inexpensive feedstocks for the electrodeposition process. Acid leaching was shown to reduce the concentration of major photovoltaic performance affecting impurities by a factor of 10 or more. Large (10 to 50 micrometers) silicon crystals have been successfully electroplated onto 1 cm x 1 cm substrate sheets. DOE

N81-11511# RCA Labs., Princeton, N. J.
THIN-FILM POLYCRYSTALLINE SILICON SOLAR CELLS Technical Progress Quarterly Report, 25 Mar. - 24 Jun. 1980
B. W. Funghnan, J. Blanc, W. Phillips, and D. Redfield Aug. 1980 54 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-AC02-77CH-00178)
(SERI/PR-0-8276-3; TPQR-3) Avail: NTIS HC A04/MF A01

Thirty-four new solar cells were fabricated on Wacker Sislo substrates and the AM-1 parameters were measured. A detailed comparison was made between the measurement of minority carrier diffusion length by the OE method and the penetrating light laser scan grain boundary photoresponse linewidth method. The laser scan method has more experimental uncertainty and agrees within 10 to 50% with the QE method. It allows determination of L over a large area. Atomic hydrogen passivation studies continued on Wacker material by three techniques. A method of determining surface recombination velocity, s, from laser scan data was developed. No change in s in completed solar cells after H-plasma treatment was observed within experimental error. H-passivation of bare silicon cars as measured by the new laser scan photoconductivity technique showed very large effects. DOE

N81-11512# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT OF AN EXPERIMENTAL TEST APPARATUS FOR NATURAL CONVECTION SOLAR COLLECTORS
W. Scott Morris 1980 6 p Presented at 5th Natl. Passive Solar Conf. Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-2329) Avail: NTIS HC A02/MF A01

An experimental test apparatus to obtain a broad experimental data base on natural convection solar collectors is described. As construction of the apparatus was completed in late February 1980, and shakedown testing was conducted during late winter, a brief evaluation of system performance and preliminary test results are presented. DOE

N81-11513# Exxon Research and Engineering Co., Linden, N.J. Government Research Labs.
ALTERNATIVE ENERGY SOURCES FOR NON-HIGHWAY TRANSPORTATION, VOLUME 1
E. N. Cart, Jr., ed. Jun. 1980 26 p refs
(Contract DE-AC05-77CS-55438)
(DOE/CS-05438/T1-Vol-1) Avail: NTIS HC A03/MF A01

Alternate fuels for nonhighway transportation (aircraft, rail, marine, and pipeline) were investigated. A recommendation of what alternate fuels may be of interest to nonhighway transportation users from now through 2025 is made. The research and development needed to allow nonpetroleum derived fuels to be used in nonhighway transportation is discussed. In the near term (present-1985), there is unlikely to be any major change in the fuels used in any of the four modes of transportation except that the average quality of the marine fuel is likely to get worse. In the midterm period (1985-2000), there will be a transition to nonpetroleum fuels, based primarily on shale oil derived liquids assuming a shale oil industry is started during this time. DOE

N81-11514# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
ANNUAL HEATING AND COOLING REQUIREMENTS AND DESIGN-DAY PERFORMANCE FOR A RESIDENTIAL MODEL IN SIX CLIMATES: A COMPARISON OF NBSLD, BLAST 2, AND DOE-2.1
William L. Carroll Jun. 1980 68 p refs Presented at the Conf. on Thermal Performance of the Exterior Envelopes of Bldgs., Orlando, Fla., 3-5 Dec. 1979
(Contract W-7405-eng-48)
(LBL-9270; EEB-ENV-79-11; CONF-791233-5) Avail: NTIS HC A04/MF A01

A comparison was made of heating and cooling load predictions made by three public domain building energy analysis computer programs: NBSLD, BLAST 2, and DOE-2.1. Three different kinds of comparisons were made: (1) monthly and annual load calculations were compared for six locations spanning the range of climates in the continential US (2) predicted changes in annual heating and cooling loads (BLAST 2 and DOE-2.1 from a baseline case were compared for a single climate (Washington, DC)); and (3) hourly heating and cooling load predictions were compared for design days that are representative of summer, winter, and transitional season weather conditions for a temperate climate. Annual heating load predictions show generally good agreement for all climates and consistent predicted changes from one climate to another, with the exception of the DOE-2.1 predictions, which show marked underestimates for mild heating climates. DOE

N81-11515# Little (Arthur D.), Inc., Cambridge, Mass.
ASSESSMENT OF THE POTENTIAL FOR HEAT RECOVERY AND LOAD LEVELING ON REFRIGERATION SYSTEMS, VOLUME 1, SUMMARY Final Report
R. L. Merriam, W. D. Lee, J. E. Carr, S. E. Boyce, and H. S. Bierenbaum Mar. 1980 47 p refs Prepared in cooperation with PRC, Systems Service Co., Cocoa Beach, Fla., and Applied Energy Systems, Inc., Cape Canaveral, Fla.
(EPRI Proj. 1087-1)
(EPRI-EM-1348-Vol-1) Avail: NTIS HC A08/MF A01

The potential energy savings from refrigerant heat recovery in the residential, commercial and industrial sectors and its impact on electric utilities were assessed. It was concluded that the technology for heat recovery is well established in all sectors and in comparison with solar water heating equivalent energy savings can be achieved at a fraction of the cost. In the absence of barriers, the potential market for heat recovery could be substantial, with an annual energy savings of 0.25 x 10 to the 15th power Btu in 1990. The economic impacts on summer peaking electric utilities were found to be favorable in all regions in central air conditioner applications. Annual net cost savings to the utility were estimated to be $10 to $50 per residential application. In the commercial sector and food processing segment of the industry sector, refrigerant heat recovery could reduce total energy consumption by about 0.28 x 10 to the 15th power Btu, with the major savings from applications in existing buildings. DOE

N81-11516# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.
ECONOMIC EVALUATION OF THE ANNUAL CYCLE ENERGY SYSTEM (ACES), VOLUME 3, APPENDICES Final Report
Jun. 1980 406 p refs
(Contract W-7405-eng-26)
(ORNL/Sub-7470/1-V3) Avail: NTIS HC A18/MF A01

Seven appendices related to ACES, the first three of which are concerned with computer programs are presented. The appendices are entitled: ACESIM: Residential Program Listing; Typical inputs and outputs OF ACESIM; CACESS: Commercial Building Program Listing; Typical Weather Year Selection Requirements; Building Characteristics; List of AJOR Variables Used in the Computer Programs; and Bibliography. DOE

N81-11517# Little (Arthur D.), Inc., Cambridge, Mass.
POTENTIAL FOR ENERGY TECHNOLOGIES IN RESIDENTIAL AND COMMERCIAL BUILDINGS
Martin M. Glesk Nov. 1979 153 p
(Contract DE-AC01-76PE-03871)
(DOE/PE-03871/T1) Avail: NTIS HC A08/MF A01

The residential commercial energy technology model was developed as a planning tool for policy analysis in the residential and commercial building sectors. The model and its procedures represent a detailed approach to estimating the future acceptance of energy using technologies both in new construction and for retrofit into existing buildings. The model organizes into an analytical framework all relevant information and data on building energy technology, building markets, and government policy, and it allows for easy identification of the relative

importance of key assumptions. The outputs include estimates of the degree of penetration of the various building energy technologies, the levels of energy use savings associated with them, and their costs both private and government. The model was designed to estimate the annual energy savings associated with new technologies compared with continued use of conventional technology at 1975 levels. DOE

N81-11518# Argonne National Lab., Ill.
NEW APPLICATIONS OF ENERGY STORAGE IN ELECTRIC HEATING AND COOLING SYSTEMS
J. G. Asbury 1980 7 p refs Presented at the IEEE Region 6 Conf., San Diego, Calif., 20-22 Feb. 1980
(Contract W-31-109-eng-58)
(CONF-800210-4) Avail: NTIS HC A02/MF A01

Electricity, in combination with appropriate load management techniques, is a cost effective method of providing building heating and cooling services. Storage systems that enable the use of nighttime, off peak, energy to meet the following day's load are among the most promising load management techniques. Studies evaluated the total cost of providing space heating and cooling services with electricity and then compared these costs with oil and gas based systems. Detailed cost allocation models were used to compute gas and electric utility costs of supply. A number of different electric technologies were evaluated including electric storage heating, storage air conditioning, dual fuel heating, and solar heating with electric backup. An important finding is that several electric based heating technologies are cost competitive with oil and natural gas heating. DOE

N81-11519# Montana Energy and MHB Research and Development Inst., Inc., Butte.
HIGH TEMPERATURE FUEL CELL RESEARCH AND DEVELOPMENT Final Technical Status Report, 1 Mar. 1979 - 31 Mar. 1980
Paul A. Lessing May 1980 133 p refs
(Contract DE-AC03-77ET-11320)
(DOE/ET-11320/T1) Avail: NTIS HC A07/MF A01

Eleven powdered candidate materials were selected based on previous physical and chemical stability tests at elevated temperatures on solid materials and/or their thermodynamic stability with respect to proposed degradation reactions. The eleven candidate materials, plus gamma lithium aluminate, were characterized prior to corrosion testing utilizing (1) Chemical Analysis, (2) X-ray Diffraction for Phase Identification, (3) Scanning Electron Microscopy (SEM), and (4) Surface Area Analysis. The powders were corrosion tested initially for 200 hours by heating to 700 C in a mixture of 62% Li2CO3-38% K2CO3 under a fuel gas atmosphere. The gas composition was based on reformed Naphtha at 700 C and consisted of 50.2% H2, 10.8% CO, 9.5% CO2, and 29.5% H2O. The samples were tested in an inert container made by coating the interior of alumina crucibles with a layer of 0.0002 inch gold. DOE

N81-11520# Department of Energy, Washington, D. C. Energy Information Administration.
ENERGY DATA REPORT: ANNUAL ENERGY BALANCE, 1978
Apr. 1979 8 p
(DOE/EIA-0181) Avail: NTIS HC A02/MF A01

US energy production in 1978 increased for the third consecutive year. The 61.0 quadrillion Btu produced in 1978 was 0.63 quadrillion Btu or 1.0% greater than that during 1977 and represented the largest annual increase since 1972. Petroleum (including crude oil, lease condensate and natural gas plant liquids) was the nation's principal domestic energy source in 1978, supplying 33.8% of total production. Electricity production from nuclear powerplants increased 10% in 1978 to a record 276 billion kWh, 12.5% of total energy output. Hydropower electricity production totaled 281 billion kWh, 27.1% above the 1977 level when output was its lowest in recent years because of drought conditions in western states. US energy consumption in 1978 totaled 78.01 quadrillion Btu, 1.9% higher than that during 1977. Consumption of refined petroleum products, the major item of energy consumption was 37.79 quadrillion Btu in 1978. DOE

N81-11521# Institute of Gas Technology, Chicago, Ill.
FUEL CELL RESEARCH ON SECOND-GENERATION MOLTEN CARBONATE SYSTEM Final Report, 1 Oct. 1978 - 31 Jan. 1980
May 1980 405 p refs
(Contract DE-AC03-78ET-11276)
(SAN-11276-4) Avail: NTIS HC A18/MF A01

The effort was conducted along three major and closely interrelated tasks. Task 1 involved the quantification of the thermomechanical behavior of the electrolyte tile, formulation of the methodology required to predict the stresses generated in the cell package during a thermal cycle, and specification and design of cell components that both reduce the thermally generated stresses and are cost effective. In Task 2 the preferred electrolyte tile support, the factors/mechanisms responsible for morphological transformations, and cost effective electrolyte powder and electrolyte tile fabrication processes were determined. Task 3 was to verify the performance, endurance, and thermal cycling characteristics of standard and developmental cell components in both laboratory and bench scale testing. Progress is reported in detail. DOE

N81-11522# Midwest Research Inst., Golden, Colo.
DEVELOPING COMMON INFORMATION ELEMENTS FOR RENEWABLE ENERGY SYSTEMS: SUMMARY AND PROCEEDINGS OF THE SERI/AID WORKSHOP
John H. Ashworth and Jean W. Neuendorffer Jun. 1980 125 p refs Conf. held at Golden, Colo., 20-22 Feb. 1980
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-744-661; CONF-800250) Avail: NTIS HC A06/MF A01

The primary objectives were to explore whether it was possible to establish common information elements that would describe the operation and impact of renewable energy projects in developing countries. Such information could be shared among institutions and used to make informed judgments on the economic, technical, and social feasibility of the technologies. Because developing countries and foreign assistance agencies will be financing an increasing number of renewable energy projects, these organizations need information on the field experience of renewable energy technologies. DOE

N81-11523# Argonne National Lab., Ill. Chemical Engineering Div.
ADVANCED FUEL CELL DEVELOPMENT Progress Report, Oct. - Dec. 1979
R. D. Pierce, G. H. Kucera, D. S. Kupperman, R. B. Poeppel, T. W. Sim, R. N. Singh, and J. L. Smith May 1980 47 p refs
(Contract W-31-109-eng-38)
(ANL-80-33) Avail: NTIS HC A03/MF A01

Advanced fuel cell research and development activities during October-December 1979 are described. These efforts were directed toward understanding and improving components of molten carbonate fuel cells and included operation of 10 cm square cells. The principal focus was on the development of electrolyte structures (LiAlO2 and Li2CO3-K2CO3) that have good electrolyte retention and mechanical properties as well as long term stability. The effort included work on preparation of sintered LiAlO2 as electrolyte support, use of a scanning laser acoustic microscope to evaluate electrolyte structures, and measurements of the thermal expansion coefficients of various mixtures of beta LiAlO2 and carbonate eutectic. DOE

N81-11524# Department of Energy, Washington, D. C.
DEPARTMENT OF ENERGY SOLAR ENERGY OBJECTIVES, CALENDAR YEAR 1980
Apr. 1980 432 p refs
(DOE/CS-0155) Avail: NTIS HC A19/MF A01

The goals of the Department of Energy for calendar year 1980 with respect to the output of each of the solar energy programs authorized by Congress are presented. The solar activities of the Department are described by the sector of the economy they are designed to serve. DOE

N81-11525# Argonne National Lab., Ill. Chemical Engineering Div.
CONCEPTUAL DESIGNS FOR UTILITY LOAD-LEVELING BATTERY WITH Li/FeS CELLS

S. M. Zivi, H. Kacinskas, I. Pollack, A. A. Chilenkas (Rockwell International, Canoga Park, Calif.), W. Grieve (Rockwell International, Canoga Park, Calif.), B. L. McFarland (Rockwell International, Canoga Park, Calif.), and S. Sudar Jul. 1980 90 p refs
(Contract W-31-109-eng-38)
(ANL-80-20) Avail: NTIS HC A05/MF A01

A conceptual design of a 100 MW-h load leveling battery system having Li alloy/FeS cells was developed. Efforts were concentrated on lowering the hardware costs which resulted in the development of three modified designs which are presented in the report. The first consisted of a 30 kW-h cell/submodule and the electric vehicle equalization scheme. The hardware cost for this modified design was quite low, about $25/kW-h; however, this design was eventually rejected owing to the apparent impracticality of such a large cell. The two other modified designs had more conservative cell designs. One of them consisted of a 120 kW-h submodule consisting of one hundred 1.2 kW-h cells; the other consisted of a 1020 kW-h submodule consisting of four hundred and eight 2.5 kW-h cells. DOE

N81-11526# Joint Center for Graduate Study, Richland, Wash.
METAL-INSULATOR-SEMICONDUCTOR PHOTOVOLTAIC DEVICES
Larry C. Olsen, John E. Garnier, and Rheal P. Turcotte Jun. 1979 27 p refs Presented at Polycrystalline Silicon Solar Cells DOE/SERI Contractors' Rev. Meeting, Arlington, Va., 14 Jun. 1980
(Contracts DE-AC06-76RL-01830; EY-76-C-06-1830)
(PNL-SA-7778; CONF-7906185-1) Avail: NTIS HC A03/MF A01

Research on metal insulator semiconductor (MIS) solar cells was conducted to improve understanding of the basic parameters which control photovoltaic processes in these cell structures. Fabrication, characterization, and theoretical studies of single crystal silicon based cells, with SiO sub x as the insulating film and Al or Au as the front metal contact are described. Studies of these two systems provide needed reference systems from which improved single crystal or polycrystalline devices can be systematically developed. The approach to cell fabrication involved growth of a SiO sub x layer on a silicon substrate, and subsequent evaporation of a metal layer for the front contact by vacuum evaporation or electron beam deposition. DOE

N81-11527# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SOLAR REPOWERING/INDUSTRIAL RETROFIT SYSTEMS STUDY: GULF MT. TAYLOR URANIUM MILL SOLAR RETROFIT, EXECUTIVE SUMMARY Final Technical Report
Jun. 1980 26 p refs Prepared in part by Gulf Research and Development Co., Pittsburgh and Houston Univ., Tex.
(Contract DE-AC03-79SF-10608)
(DOE/SF-10608-Exec-Summ; MDC-G8656ES) Avail: NTIS HC A03/MF A01

A nine month study to develop a site specific conceptual design for solar industrial retrofit of the Gulf Mt. Taylor Uranium Mill is described. This has resulted in preparation of a System Requirements Specification, conduct of trade studies leading to selection of a system concept, and conceptual design, performance, cost estimating and economic analysis of the selected concept. A baseline system with no storage and an alternative system with extended storage were evaluated. The baseline system with no storage was selected because it provides the best overall opportunity for fuel displacement, operating experience in industrial application and successful demonstration in the near term for both DOE and the user. DOE

N81-11528# Acurex Corp., Mountain View, Calif. Alternate Energy Div.
FURTHER DEVELOPMENT OF A LOW COST SOLAR PANEL Final Report, 28 Sep. 1979 - 31 May 1980
T. Muller, R. Torok, D. Erskine, and R. Short Jul. 1980 81 p refs
(Contract DE-AC04-79AL-12032)
(ALO-2032-2) Avail: NTIS HC A05/MF A01

A full-scale prototype panel section, with emphasis on the unglazed configuration was fabricated and tested. Design refinement, fabrication of full-scale prototypes by hand and semiautomated equipment, subscale and full-scale structural testing, outdoor performance tests, and an assessment of manufacturing requirements and production costs are included. The Low Cost Solar Panel, the project approach, and the more significant accomplishments of this contract are described in detail. DOE

N81-11529# Middlebury Coll., Vt.
MODE VALIDATION AND SENSITIVITY ANALYSIS OF SOLAR COLLECTOR LOOPS Final Technical Report
30 Jul. 1980 18 p
(Contract DE-AC03-80CS-30218)
(DOE/CS-30218/1; SAN-30218-1) Avail: NTIS HC A02/MF A01

The experimental solar collector systems at Middlebury College were modified to permit short time resolution studies of solar collector loop performance. A variety of experiments were performed to measure the following system properties: collector efficiency, collector response to step changes in insolation, collector response to the introduction of cold inlet water, and pump cycling as a function of control sensor location and set points. Data from these experiments was supplied to the solar group at Drexel for validation of their analytical collector loop model. DOE

N81-11530# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.
DEVELOPMENT OF INTERMEDIATE TEMPERATURE THERMAL STORAGE SYSTEMS Final Technical Report, 1 Apr. 1978 - 31 May 1979
Jerzy R. Moszynski, Seluck I. Guceri, David Y. S. Lou, and Gregory L. Tietbohl 1979 63 p
(Contracts DE-AS05-78CS-35760; EM-78-S-05-5760)
(DOE/CS-35760/T1) Avail: NTIS HC A04/MF A01

Attention was focused during the period covered on prospective heat storage materials in the temperature range from 100 to 300 C for use with residential air conditioning systems. Special instruments were designed, tested and commissioned during the period. These include: two cells for the determination of the heat of fusion of large scale samples; a cell for the determination of thermal diffusivity; and a device for automatic thermal cycling of large samples. A set of criteria was established for the selection of potential storage materials from the point of view of cost, safety, and suitability for systems under development. Author

N81-11531# Oak Ridge Y-12 Plant, Tenn.
DATA ANALYSIS TECHNIQUES USED AT THE OAK RIDGE Y-12 PLANT FLYWHEEL EVALUATION LABORATORY
R. S. Steels, Jr. and E. F. Babelay, Jr. 14 Jul. 1980 14 p refs Presented at the Flywheel Technol. Symp., Scottsdale, Ariz., 19-24 Oct. 1980
(Contract W-7405-eng-26)
(Y/DX-135; CONF-801022-1) Avail: NTIS HC A02/MF A01

Some of the more advanced data analysis techniques applied to the problem of experimentally evaluating the performance of high performance composite flywheels are presented. Real time applications include polar plots of runout with interruptions relating to balance and relative motions between parts, radial growth measurements, and temperature of the spinning part. The technique used to measure torque applied to a containment housing during flywheel failure is also presented. The discussion of pre and post test analysis techniques includes resonant frequency determination with modal analysis, waterfall charts, and runout signals at failure. DOE

N81-11532# Sandia Labs., Albuquerque, N. Mex. Applied Mechanics Div.
VAWTDYN: A NUMERICAL PACKAGE FOR THE DYNAMIC ANALYSIS OF VERTICAL AXIS WIND TURBINES
D. W. Lobitz and W. N. Sullivan Jul. 1980 64 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-0085) Avail: NTIS HC A04/MF A01

The VAWTDYN package which provides a tool for assessing dynamic amplifications in two bladed vertical axis wind turbines is described. The dynamic model on which the package is based contains turbine motions most commonly observed in existing research systems. Gyroscopic effects, structural damping,

aerodynamic wind loading, and power generation through either an induction or synchronous generator are also included in the model. In addition to a comprehensive description of the model, the efforts that have gone into the verification, qualification, and demonstration of the package are documented. DOE

N81-11533# Westinghouse Research and Development Center, Pittsburgh, Pa. Physical and Organic Chemistry.
LOW-COST SUBSTRATES FOR POLYCRYSTALLINE SILICON SOLAR CELLS BY ELECTRODEPOSITION PROCESSES Quarterly Progress Report, 1 Oct. - 31 Dec. 1979
W. R. Gass, I. E. Kanter, and R. E. Witkowski 14 Mar. 1980 29 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-8119-2-T1; QPR-1) Avail: NTIS HC A03/MF A01

Economical processes for fabricating large grain size polycrystalline silicon substrates by electrodeposition techniques suitable for photovoltaic applications are discussed. The technical feasibility for producing thin film polycrystalline silicon sheet by molten salt electrolytic plating techniques is specifically addressed. Purified metallurgical grade silicon and silica is investigated as inexpensive feedstocks for the electrodeposition process. DOE

N81-11534# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SOLAR REPOWERING/INDUSTRIAL RETROFIT SYSTEMS STUDY: GULF MT. TAYLOR URANIUM MILL SOLAR RETROFIT Final Technical Report
Jun. 1980 281 p refs Prepared in cooperation with Gulf Research and Development Co., Pittsburgh and Houston Univ., Tex.
(Contract DE-AC03-79SF-10608)
(DOE/SF/10608-1; MDC-G8656) Avail: NTIS HC A13/MF A01

The efforts in a nine month study to develop a site specific conceptual design for solar tower focus collector industrial retrofit of the Gulf Mt. Taylor Uranium Mill are described. Details of the conceptual design, subsystem characteristics, economic analysis, and development plan are presented. DOE

N81-11535# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
NATIONAL COMMERCIAL SOLAR HEATING AND COOLING DEMONSTRATION: PURPOSES, PROGRAM ACTIVITIES, AND IMPLICATIONS FOR FUTURE PROGRAMS
Richard Koontz, Michael Genest, and Becky Bryant May 1980 34 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/RR-431-328) Avail: NTIS HC A03/MF A01

The Commercial Demonstration Program was assessed in terms of its stated goals and objectives. The primary data base was DOE contractor reports on commercial demonstration projects. The program did not provide data to support a positive decision for the immediate construction or purchase of commercial solar systems. However, the program may have contributed to other goals in the subsequent legislation; i.e., research and development information, simulation of the solar industry, and more informed policy decisions. DOE

N81-11536# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
FUTURE OF PHOTOVOLTAIC ENERGY CONVERSION IN DEVELOPING COUNTRIES
Steve Hogan Apr. 1980 52 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-611-407) Avail: NTIS HC A04/MF A01

Recent studies reveal that photovoltaic energy conversion is economically viable for usage in developing countries. An overview of programs designed to lower the costs of such conversion systems is presented. Government goals are reviewed, as well as application projects relative to rural usage. A summary of the state of the art in both advanced research and commercially available technology is presented. It is concluded that with the range of the work being done, such systems will be viable for many rural applications within 5 years. DOE

N81-11537# Battelle Columbus Labs., Ohio.
REVIEW OF STATE-OF-THE-ART OF SOLAR COLLECTOR CORROSION PROCESSES. TASK 1 OF SOLAR COLLECTOR STUDIES FOR SOLAR HEATING AND COOLING APPLICATIONS Final Technical Progress Report
J. E. Clifford and R. B. Diegle 11 Apr. 1980 183 p refs
(Contract DE-AC04-79CS-10510)
(DOE/CS-10510/T12) Avail: NTIS HC A09/MF A01

The state of the art of solar collector corrosion processes is reviewed, and Task 1 of a current research program on use of aqueous heat transfer fluids for solar heating and cooling is summarized. The review of available published literature indicated that lack of quantitative information exists relative to collector corrosion at the present time, partucularly for the higher temperature applications of solar heating and cooling compared to domestic water heating. Solar collector systems are reviewed from the corrosion/service life viewpoint, with emphasis on various applications, collector design, heat transfer fluids, and freeze protection methods. Available information (mostly qualitative) on collector corrosion technology is reviewed to indicate potential corrosion problem areas and corrosion prevention practices. DOE

N81-11538# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DYNAMIC ANALYSIS OF A MAGNETICALLY SUSPENDED ENERGY STORAGE WHEEL
L. L. Bucciarelli (MIT, Cambridge) and A. Rangarajan 1980 8 p refs Presented at the Flywheel Technol. Symp., Scottsdale, Ariz., 26-30 Oct. 1980
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/102; CONF-801022-3) Avail: NTIS HC A03/MF A01

The results of an analysis conducted in support of the design of a I kWh flywheel fabricated and tested recently at the MIT Lincoln Laboratory are presented. The flywheel was a prototype of a 40 kWh residential unit to be used to store energy obtained from photovoltaic arrays. The I kWh system was designed to operate between 7500 and 15,000 rpm. The flywheel, made of seven 15 inch diameter steel disks, weighed about 400 pounds, and was suspended vertically by a flexible quill shaft from a set of six magnetic bearings. The magnetic bearings minimize frictional losses and require little maintenance over the design life of the system. The quill shaft, which permits self-alignment of the wheel's principal axis with the spin axis, was sized so that there are no critical frequencies in the operating range. An integral motor/generator unit was used to spin the wheel up when power is available and to generate power when required. DOE

N81-11539# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PERFORMANCE TESTING AND ECONOMIC ANALYSIS ON A PHOTOVOLTAIC FLYWHEEL ENERGY STORAGE AND CONVERSION SYSTEM
R. D. Hay, A. R. Millner, and P. O. Jarvinen 1980 9 p refs Presented at the Flywheel Technol. Symp., Scottsdale, Ariz., 26-30 Oct. 1980
(Contract DE-AC02-76ET-20279)
(COO-4094-91; CONF-801022-2) Avail: NTIS HC A02/MF A01

A subscale prototype of a flywheel energy storage and conversion system for use with photovoltaic power systems of residential and intermediate load-center size was designed, built and tested. System design, including details of such key components as magnetic bearings, motor generator, and power conditioning electronics, is described. Performance results of prototype testing are given and indicate that this system is the equal of or superior to battery-inverter systems for the same application. Results of cost and user worth analysis show that residential sytems are economically feasible in stand alone and in some utility interactive applications. DOE

N81-11540# Los Alamos Scientific Lab., N. Mex.
NATURAL CONVECTIVE HEAT TRANSFER THROUGH AN APERTURE IN PASSIVE SOLAR HEATED BUILDINGS
Dennis D. Weber and Robert J. Kearney (Idaho Univ., Moscow) 1980 6 p refs Presented at 5th Natl. Passive Solar Conf., Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2328; CONF-801016-13) Avail: NTIS HC A02/MF A01

The heat transfer through doorways by natural convection was measured in a similarity model experiment and in two

buildings of greatly differing geometry. The heat transfer can be expressed as a simple function of doorway geometry and any one of several temperature differentials. DOE

N81-11541# Los Alamos Scientific Lab., N. Mex.
ATTACHED SUNSPACE HEATING PERFORMANCE ESTIMATES
Robert W. Jones and Robert D. McFarland 1980 6 p refs Presented at the 5th Natl. Passive Solar Conf., Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2236; CONF-801016-3) Avail: NTIS HC A02/MF A01

Heating performance in terms of an annual solar savings fraction (SSF) was estimated for attached-sunspace (or attached-greenhouse) types of passively solar; heated buildings. The estimation method is computer simulation method using sunspace model in the framework of PASOLE, a passive solar energy simulation program. Certain reference designs were used to provide a first estimate of performance for various locations. The primary emphasis of the present paper is to report estimates of the variations in performance as a result of variations of certain design parameters from their reference values. Design parameters varied include thermal storage volume, thermocirculation vent areas, sunspace-to-living-space well thermal resistance, sunspace infiltration rate, extent of lightweight sunspace objects, glazing tilt, and other sunspace geometry variations. DOE

N81-11542# Los Alamos Scientific Lab., N. Mex.
CONSERVATION AND SOLAR: WORKING TOGETHER
J. Douglas Balcomb 1980 8 p refs Presented at the 5th Natl. Passive Solar Conf., Amherst, Mass., 19-26 Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2330; CONF-802026-11) Avail: NTIS HC A02/MF A01

A methodology is developed for optimally allocating resources between conservation and solar strategies in building design. Formulas are presented for a constrained optimum in which the initial investment is limited. A global optimum procedure is also described in which life cycle cost is minimized. The procedure is amenable to hand analysis if tables are available which give the solar savings fraction as a function of the load collector ratio for the locality. DOE

N81-11543# Brookhaven National Lab., Upton, N. Y. Energy Data and Models Group.
COMPARATIVE REVIEW OF THE TIME-STEPPED ENERGY SYSTEM OPTIMIZATION MODEL (TESOM) AND THE IEA MARKET ALLOCATION MODEL (MARKAL)
Andy S. Kydes Apr. 1980 16 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51199) Avail: NTIS HC A02/MF A01

The two principal energy system models used in the National Center for Analysis of Energy Systems at Brookhaven National Laboratory are described and their important differences are discussed. DOE

N81-11544# Florida Univ., Gainesville. Solar Energy Lab.
VEGETABLE OILS: LIQUID COOLANTS FOR SOLAR HEATING AND COOLING APPLICATIONS Final Report
Herbert A. Ingley Feb. 1980 104 p refs
(Contract DE-AC04-78CS-34298; EM-78-C-04-4298)
(ALO-4298-2) Avail: NTIS HC A06/MF A01

Vegetable oils, renewable byproducts of agriculture processes, were investigated for possible use as liquid coolants. Several thermophysical properties of four vegetable oils were investigated. Vapor pressures, specific heat, viscosity, density, and thermal conductivity were determined over a range of temperatures for corn, soybeans, peanut, and cottonseed oil. ASTM standard methods were used for these determinations. In addition, chemical analyses were performed on samples of each oil. The samples were collected before and after each experiment so that any changes in composition could be noted. The tests included iodine number, fatty acid, and moisture content determination. DOE

N81-11545# Total Environmental Action, Inc., Harrisville, N.H.
PASSIVE SOLAR DESIGN HANDBOOK. VOLUME 1: PASSIVE SOLAR DESIGN CONCEPTS
Bruce Anderson Mar. 1980 374 p refs
(Contract W-7405-eng-36)
(DOE/CS-0127/1) Avail: NTIS HC A16/MF A01

The following topics are covered: background to passive solar building design; the basics of solar building design; five passive solar heating techniques: direct gain, convective loops, thermal storage walls, thermal storage roofs, and attached sunspaces, passive solar cooling; and new developments for future use. A glossary and bibliography are included. DOE

N81-11546# American Planning Association, Chicago, Ill.
SITE PLANNING FOR SOLAR ACCESS: A GUIDEBOOK FOR RESIDENTIAL DEVELOPERS AND SITE PLANNERS
Duncan Erley and Martin Jaffe Sep. 1979 156 p refs Prepared in cooperation with Living Systems, Winters, Calif.
(Contract EX-76-A-29-1020)
(HUD-PDR-481) Avail: NTIS HC A08/MF A01

A guide for developers, site planners, and builders which assists in the design of residential developments for solar access was compiled. Data included in an evaluation of site selection and analysis are the Sun's positions, latitude and topography, atmospheric conditions, existing shading and shading by natural and man made objects, energy conservation, and site assessment criteria. Criteria reviewed for preliminary site planning include solar access objectives, local regulations, site planning criteria, procedures and an analysis checklist. The relationship of building and site design building orientation and solar access, and techniques for analyzing solar access are considered. Design strategies to protect solar access include road layout, lot design, open space planning, and siting strategies for single family detached, low rise multifamily, and high rise housing. Other considerations for building orientation include trees, landscaping, and vegetation utilization. Two examples of solar site planning and building orientation are provided. DOE

N81-11547# Ames Lab., Iowa.
OPERATIONAL EXPERIENCES FROM THE FEDERAL SOLAR HEATING AND COOLING DEMONSTRATIONS
Paul H. Sidles 1980 9 p Presented at the 2d Ann. Iowa Solar Operational Results Conf., Des Moines, 19-20 Jun. 1980
(Contract W-7405-eng-82)
(IS-M-286; CONF-8006115-2) Avail: NTIS HC A02/MF A01

The functional and economic feasibility of solar heating and cooling buildings is discussed. The establishment of a viable solar industry to achieve a substantial reduction in the use of fossil fuel through the widespread use of solar heating and cooling was investigated. Performance data are currently published monthly for each instrumented site in the national solar heating and cooling demonstration program. As these reports accumulate they provide an ongoing basis for evaluating the performance of solar systems and can be utilized for illustration of many of these lessons learned from operational experience. The general status of the demonstration program and experience gained are discussed. DOE

N81-11548# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR MOULDER CORPORATION SINGLE FAMILY RESIDENCE, GREENWOOD, INDIANA
17 Jul. 1980 47 p
(Contract DE-AB01-76CS-31020)
(SOLAR/1001-80/50) Avail: NTIS HC A03/MF A01

The system is designed to provide solar energy for space heating and domestic hot water heating. Solar energy is used for space heating the home and preheating domestic hot water (DHW). The solar energy system has an array of flat plate collectors with a gross area of 704 square feet. The array faces 5.5 degrees west of south at an angle of 45 degrees to the horizontal. Air is the transfer medium that delivers solar energy from the collector array to storage, space heating and hot water loads. Solar energy is stored underground in 945 cubic foot bin containing 81,000 pounds of crushed rock. The bin has 8 inch concrete block walls and the insulation on the exterior is sprayed urethane. Preheated city water is stored in an 80 gallon preheat tank, which is inside the storage bin and is supplied, on demand, to a conventional 52 gallon DHW tank. When solar energy is insufficient to satisfy the space heating load, a conventional electric furnace provides the auxiliary energy for space heating. DOE

N81-11549# Boeing Co., Seattle, Wash.
SOLAR PROJECT DESCRIPTION FOR DESIGN CONSTRUCTION ASSOCIATION SINGLE FAMILY DWELLING, BIG FORK, MONTANA
4 Apr. 1980 62 p
(Contract DE-AB01-76CS-31020)
(SOLAR/1029-80/50) Avail: NTIS HC A04/MF A01

A solar energy system was installed in a 2100 sq ft house located in Big Fork, Montana. The system is designed to provide solar energy for heating and domestic hot water. Solar energy is collected by flat plate collectors with a gross area of 792 square feet. The collector banks are mounted on the roof of the house and face due south at an angle of 45 deg to the horizontal optimizing solar energy collection. Solar energy is transferred from the collector array to a 1500 gallon storage tank. Water is used as the heat collection, transfer and storage medium. Freeze protection is provided by use of a drain down system. Space heating demands are met by circulating hot water from storage through baseboard units in the distribution system of the house. Auxiliary space heating is provided by an electrical heating element in the boiler. Similarly, an electrical heating element in the DHW tank provides energy for water heating. The dwelling was fully instrumented for performance evaluation since October 1977 and the data is integrated into the National Solar Data Network. DOE

N81-11550# Midwest Research Inst., Golden, Colo. Systems Development Branch.
PRELIMINARY REQUIREMENTS FOR THERMAL STORAGE SUBSYSTEMS IN SOLAR THERMAL APPLICATIONS
R. J. Copeland Apr. 1980 229 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/RR-731-364) Avail: NTIS HC A11/MF A01

Methodologies for the analysis of value and comparing thermal storage concepts are presented. Value is a measure of worth and is determined by the cost of conventional fuel systems. Value data for thermal storage in large solar thermal electric power applications are presented. Thermal storage concepts must be compared when all are performing the same mission. A method for doing that analysis, called the ranking index, is derived. Necessary data to use the methodology are included. DOE

N81-11551# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SNOW-COVERING EFFECTS ON THE POWER OUTPUT OF SOLAR PHOTOVOLTAIC ARRAYS
Bronwyn L. Brench Dec. 1979 29 p refs
(Contract DE-AC02-76ET-20279)
(COO-4094-61) Avail: NTIS HC A03/MF A01

In general, snow covering a photovoltaic panel causes negligible energy loss when the snow is light and melts easily; however, a more serious loss can occur when the snow is heavy and does not quickly melt or shed. In order to examine the effects of snow cover on the output energy available from photovoltaic modules, a small scale snow shedding experiment was conducted during winter at the Natural Bridges National Monument in Utah. This site was chosen since it was the planned location for a 100 kWp flat plate photovoltaic power system. Daily array power output and weather measurements were recorded by a data logger, and time lapse photographs were taken of the array. The analysis of these data and conclusions concerning the dependence of power loss on type of snow, weather conditions, and panel angle are discussed. DOE

N81-11552*# Ames Lab., Iowa. Materials Science Program.
EFFICIENT SOLAR CELLS BY SPACE PROCESSING Final Report, 1 Oct. 1978 - 14 Dec. 1979
F. A. Schmidt, G. J. Campisi, A. J. Bevolo, H. R. Shanks, and D. E. Williams 1979 78 p refs
(NASA Order H-343288; Contract W-7405-eng-82)
(NASA-CR-163683; IS-4723) Avail: NTIS HC A05/MF A01 CSCL 10A

Thin films of electron beam evaporated silicon were deposited on molybdenum, tantalum, tungsten and molybdenum disilicide under ultrahigh vacuum conditions. Mass spectra from a quadrapole residual gas analyzer were used to determine the partial pressure of 13 residual gases during each processing step. Surface contamination and interdiffusion were monitored by in situ Auger electron spectrometry. The presence of phosphorus in the silicon was responsible for attaining elevated temperatures with silicide formations. Heteroepitaxial silicon growth was sensitive to the presence of oxygen during deposition, the rate and length of deposition as well as the substrate orientation. DOE

N81-11553# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS: THE RALPH WILLIAMSON HOUSE
Jun. 1980 34 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-5) Avail: NTIS HC A03/MF A01

This house uses direct gains on the massive floor and walls. In addition to a large expanse of south facing windows is a large clerestory. The environment, building, passive solar system, data acquisition system, and thermal performance are described. DOE

N81-11554# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS: THE LOS ALAMOS SCIENTIFIC LABORATORY TEST ROOMS
Jun. 1980 23 p
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-2) Avail: NTIS HC A02/MF A01

Direct gain and Trombe wall test cells were constructed for use in assessing the performance of such systems and to provide data for the validation of a computer model. The environment, building, passive solar system, and data acquisition system are described for each cell. Graphs and tables of weather and validation variables are included. DOE

N81-11555# Bickle/CM, Inc., Albuquerque, N. Mex.
PERFORMANCE DATA FOR PASSIVE SYSTEMS: THE BRUCE HUNN HOUSE
Jun. 1980 38 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-0924-6) Avail: NTIS HC A03/MF A01

A 1955 sq ft house which uses a Trombe wall for space heating as well as direct gain is discussed. A rock bed storage box which is actively charged has not operated satisfactorily. The house, the envrionment, the solar system, and the data acquisition system are described. Annual and hourly test data for the house are presented. DOE

N81-11556# New Mexico State Univ., Las Cruces. Dept. of Chemical Engineering.
PRELIMINARY RESULTS FROM BENCH-SCALE TESTING OF A SULFUR-IODINE THERMOCHEMICAL WATER-SPLITTING CYCLE
D. OKeefe, C. Allen, G. Besenbruch, K. McCorkle, J. Norman, and R. Sharp Jul. 1980 45 p refs Presented at the 20th Joint AICHE-IMIQ Meeting, Acapulco, Mexico, 15-17 Oct. 1980 Prepared in cooperation with General Atomic Co., San Diego, Calif.
(Contract DE-AC02-80ET-26225; GA Proj. 3332; GA Proj. 2252; GA Proj. 2306)
(GA-A-15935; CONF-801028-1) Avail: NTIS HC A03/MF A01

Portions of a bench-scale model of a sulfur-iodine thermochemical water-splitting cycle were operated at General Atomic Company as part of a comprehensive program to demonstrate the technology for hydrogen production from nonfossil sources. The bench-scale model consists of three subunits which can be operated separately or together and is capable of producing as much as 4 std liters/min of gaseous hydrogen. The results of on-going parametric studies to determine the operating characteristics, performance, and capacity limitations of major components are presented. DOE

N81-11557# Hudson Inst., Inc., Croton-on-Hudson, N. Y.
FUTURE ROLE OF GEOPRESSURED RESOURCES IN US ENERGY POLICY. A SCENARIO APPROACH AND ANALYSIS Final Report, 1 Jul. 1978 - 31 Mar. 1979
William M. Brown Apr. 1979 66 p refs
(Contract DE-AC02-78ET-28474)
(COO-4955-1) Avail: NTIS HC A04/MF A01

The potential contribution of future geopressured energy, especially methane, to the US and the world's needs is examined

through several scenarios. Although such production may not become competitive, if it does the eventual productible reserves from the Gulf Coast region seem likely to fall between 100 and 10,000 quads. The world's potential from similar resources is not known but may well be 10 times as great. The contribution to the projected future demand for hydrocarbons is found to become substantial in most of the success scenarios. The potential impact on fuel imports and their future prices is discussed. DOE

N81-11558# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

EFFECTS OF ATMOSPHERIC VARIABILITY ON ENERGY UTILIZATION AND CONSERVATION

Elmar R. Reiter, C. C. Burns, H. Cochrane, G. R. Johnson, H. Leong, and J. D. Sheaffer Jul. 1980 86 p refs
(Contract DE-AS02-76EV-01340)
(COO-1340-76) Avail: NTIS HC A05/MF A01

Atmospheric circulation and climate variability, urban mesoclimate, energy demand modeling, and economic implications of weather variability and energy demand are studied. DOE

N81-11559# Department of Energy, Washington, D. C. Regulatory and Competitive Analysis Div.

ENERGY POLICY STUDY. VOLUME 12: GOVERNMENT ACTIONS AFFECTING THE ENVIRONMENT AND THEIR EFFECTS ON ENERGY MARKETS

Charlie McCorm[illegible] Aug. 1980 52 p refs
(DOE/EIA-0201/12) Avail: NTIS HC A04/MF A01

The energy/environment tradeoff is described. The relationship between energy production and consumption and environmental pollution is discussed. Data are presented showing some of the pollutants which arise from the production and use of energy. The data indicate that the most severe problems with energy pollution are associated with coal production and consumption. A description is given of the major environmental laws which restrict energy production and uses to protect air, water, land, and life forms. The environmental laws are most likely to effect energy production and consumption activities which produce large quantities of pollutants or small quantities of toxic and hazardous pollutants. As energy prices continue to rise and domestic oil and natural gas supplies continue to decline, the lands withdrawn from energy development will become increasingly valuable as potential sources of energy. DOE

N81-11560# National Technical Information Service, Springfield, Va.

ENERGY CONSERVATION: INDUSTRY. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jun. 1980

Audrey S. Hundemann Jul. 1980 45 p Supersedes NTIS/PS-79/0648
(PB80-812910; NTIS/PS-79/0648) Avail: NTIS *HC $30.00/MF $30.00* CSCL 10A

The 335 citations, 37 of which are new entries, discuss potential methods of conserving energy. Many abstracts deal with reports that also cover processes used, amount of energy consumed, and environmental considerations of energy conserving options. Industries covered include food, paper, chemical, cement, metals, petroleum refining, contract construction, synthetic rubber, plastics, drug manufacturing, and stone, clay, and glass. Energy conservation through the use of waste heat is covered in a related Published Search entitled Waste Heat Utilization. GRA

N81-11561# National Technical Information Service, Springfield, Va.

MICROWAVE HEATING: INDUSTRIAL APPLICATIONS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE

Progress Report, 1970 - May 1980
William E. Reed Jun. 1980 236 p Supersedes NTIS/PS-79/0632; NTIS/PS-78/0572
(PB80-812084; NTIS/PS-79/0632; NTIS/PS-78/0572) Avail: NTIS HC $30.00/MF $30.00 CSCL 13A

Industrialized uses of microwave heating are covered in 225 citations, 22 of which are new entries. The topics include industrial heating and drying for processes such as paper drying, vulcanization, and textile processing. Equipment design and safety are also cited. GRA

N81-11562# Office of Technology Assessment, Washington, D. C.

AN ASSESSMENT OF OIL SHALE TECHNOLOGIES

Jun. 1980 522 p refs
(PB80-210115; OTA-M-118; LC-80-600101) Avail: NTIS HC A22/MF A01 CSCL 10A

The means of developing the oil shale resources of the western United States is explored and the consequences of development in terms of impact on the physical and social environments is reviewed. Background information on the nature of oil shale is provided as is an evaluation of technologies for recovery of shale oil. Policy options which address barriers that could hinder the establishment of the industry are presented. GRA

N81-11563# Office of Technology Assessment, Washington, D. C.

AN ASSESSMENT OF OIL SHALE TECHNOLOGIES. VOLUME 2: A HISTORY AND ANALYSIS OF THE FEDERAL PROTOTYPE OIL SHALE LEASING PROGRAM

Jul. 1980 83 p refs
(PB80-210123; OTA-M-119; LC-80-600102) Avail: NTIS HC A05/MF A01 CSCL 10A

The Federal Prototype Oil Shale Leasing Program that began in 1974 when the U.S. Department of the Interior sold leases to four tracts in the oil shale regions of Colorado and Utah is discussed. A prior leasing attempt in 1968 is also described because it provides an historical perspective about the imperatives and the restraints that have inhibited such development. The report includes discussions of political, economic, environmental, and energy-related factors that affected both the 1968 leasing attempt and its successor, and status are examined to determine if those goals have been met or are likely to be met in the foreseeable future. DOE

N81-11564# Franklin Research Center, Philadelphia, Pa.

PERFORMANCE DATA FROM THE RESIDENTIAL SOLAR DEMONSTRATION PROGRAM *Interim Report*

1980 116 p Sponsored in part by DOE
(PB80-206642; HUD-0001492) *Avail:* NTIS HC A06/MF A01 CSCL 05K

Information from three performance-related data bases covering some of the solar homes built under the Residential Solar Demonstration Program was surveyed and analyzed in order to identify the design and installation factors that help a solar energy system perform to its maximum potential. Data from instrumentation show that only 2 of the 17 active space heating systems have performed up to predictions, but 3 of the 5 domestic hot water systems performed better than predicted. Data from utility bills comparing solar and regular houses show that over two-thirds of the solar houses used less total gas or electric energy than comparative houses in the same locales, but on a case-by-case basis, the comparison of the utility bills is highly variable. Information from troubleshooting reports shows that through all of the first three cycles, collectors remain the equipment for which the most problems were reported. GRA

N81-11995*# Alabama Univ. in Huntsville. Dept. of Mechanical Engineering.

VALIDATION OF THE SOLAR HEATING AND COOLING HIGH SPEED PERFORMANCE (HISPER) COMPUTER CODE

Donald B. Wallace *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 23 p refs (For *primary document see N81-11977 02-99*)
Avail: NTIS HC A99/MF A01 CSCL 10A

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N81-11565*# *National Aeronautics and Space Administration.* Langley Research Center, Hampton, Va.

EXPERIMENTAL STUDY OF CLUSTER FORMATION IN *BINARY MIXTURE OF H2O AND H2SO4 VAPORS IN THE* PRESENCE OF AN IONIZING RADIATION SOURCE

Jag J. Singh, Alphonso C. Smith, and Glenn K. Yue (Inst. for Atmospheric Optics and Remote Sensing, Hampton, Va.) Nov. 1980 30 p refs
(NASA-TP-1735; L-13878) Avail: NTIS HC A03/MF A01 CSCL 13B

Molecular clusters formed in pure nitrogen containing H2O and H2SO4 vapors and exposed to a 3 mCi Ni63 beta source were studied in the mass range 50 to 780 amu using a quadrupole mass spectrometer. Measurements were made under several combinations of relative humidity and relative acidity ranging from 0.7 to 7.5 percent and 0.00047 to 0.06333 percent, respectively. The number of H2SO4 molecules in the clusters observed ranged from 1 to 7 whereas the number of H2O molecules ranged from 1 to 16. The experimental cluster spectra differ considerably from those calculated using the classical nucleation theory. First order calculations using modified surface tension values and including the effects of multipole moments of the nucleating molecules indicate that these effects may be enough to explain the difference between the measured and the calculated spectra. Author

N81-11566# Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
ENVIRONMENTAL DATA FOR SITES IN THE NATIONAL SOLAR DATA NETWORK
Jun. 1980 271 p refs
(Contract DE-AC01-79CS-30027)
(SOLAR/0010-80/06) Avail: NTIS HC A12/MF A01

Available meteorological data are tabulated for reporting sites in the national solar data network: The following parameters are emphasized: insulation, temperature, wind, and relative humidity. DOE

N81-11567# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
ECONOMIC MEASUREMENT OF ENVIRONMENT DAMAGES
F. Krawiec May 1980 78 p refs
(Contract DE-AC02-77CH-00178)
(SERI/RR-744-311) Avail: NTIS HC A05/MF A01

The literature review indicated that numerous studies have assessed the physical and monetary damage to populations at risk from excessive concentrations of major air and water pollutants sulfur dioxide, total suspended particulate matter, oxidants, and carbon monoxide in air; and nutrients, oil, pesticides, and toxic metals and others in water. National gross damages of air pollution of $20.2 billion and of water pollution of $11.1 billion for 1973 are substantial. These best estimates, updated for the economic and demographic conditions, could provide acceptable control totals for estimating and predicting benefits and costs of abating air and water pollution emissions. The major issues to be resolved are: (1) lack of available noneconomic data; (2) theoretical and empirical difficulties of placing a value on human life and health and on benefits such as aesthetics; and (3) lack of available demographic and economic data. DOE

N81-11568# Los Angeles-Orange County Metropolitan Area Project, Whittier, Calif.
EVALUATION OF FAST RESPONSE AEROSOL MASS MONITORS
C. I. Fairchild, M. I. Tillery, and H. J. Ettinger Jun. 1980 76 p refs
(Contract W-7405-eng-36)
(LA-8220) Avail: NTIS HC A05/MF A01

Five commercially available mass monitors were evaluated against aerosols of coal dust, silica, fiber glass, welding fume, oil shale, polystyrene latex, dioctyl phthalate, and fluorescein dye. The RDM-201 was a long term sampler (sampling up to 8 h), whereas the other monitors employed sampling periods generally 2 min or less. Each mass monitor sampled from uniform aerosol concentrations ranging from less than 0.1 to greater than 10 mg/cubic meters. The aerosols were also sampled by three membrane filters collecting 2, 5, and 20 to 37 L/min. Mass monitor readings were compared to gravimetric concentrations of samples between 1 to 10 min duration. Statistical techniques were applied to determine significant differences between gravimetric and mass monitor results. The RDM-201 mass monitor displayed zero mass concentration of 27 of 73 measurements and an accuracy of +-74 percent for 27 other measurements, when gravimetric information indicated mass concentrations ranging from 0.3 to 5 mg/cubic meters. DOE

N81-11569# Oak Ridge National Lab., Tenn. Health and Safety Research Div.
COMPUTER CODES FOR ENVIRONMENTAL ASSESSMENTS
C. A. Little 1980 58 p refs
(Contract W-7405-eng-26)
(DOE/TIC-11228) Avail: NTIS HC A04/MF A01

Computer codes used for various phases of radiological environmental assessment are discussed. Particular transport pathways include atmospheric dispersion, surface water flow, and ground-water flow. Codes which include terrestrial and aquatic food chains and human dietary and behavioral factors are identified. There are several codes that calculate dose equivalent from both external and internal sources. Where possible, the language, appropriate computers and documentation for each code are identified. DOE

N81-11570# Argonne National Lab., Ill. Energy and Environmental Systems Div.
COSTS AND WATER QUALITY EFFECTS OF CONTROLLING POINT AND NONPOINT POLLUTION SOURCES
Charles M. Macal and Barbara J. Broomfield Jan. 1980 24 p refs Prepared in cooperation with Chicago Univ., Ill.
(Contract W-31-109-eng-38)
(ANL/ES-99) Avail: NTIS HC A02/MF A01

Costs and water quality effects of controlling point and nonpoint pollution sources are compared for the DuPage River basin in northern Illinois. Costs are estimated for effluent standards for municipal wastewater treatment plants and for the alternative, controlling runoff from nonpoint sources such as streets, agricultural lands, and forests. A dynamic water quality/hydrology simulation model is used to determine water quality effects of various treatment plant standards and nonpoint source controls. Costs and water quality data are combined, and the point source and nonpoint source and nonpoint source plans are compared on a cost effectiveness basis. Nonpoint source controls are found to be more cost effective than stricter control of pollutants from point sources. DOE

N81-11571# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ANNUAL EMISSIONS AND AIR-QUALITY IMPACTS OF AN URBAN AREA DISTRICT HEATING SYSTEM: BOSTON CASE STUDY
Stephen S. Bernow, David R. McAnulty, Steven Buchsbaum, and Elliott Levine Feb. 1980 106 p refs Prepared in cooperation with Energy Systems Research Group, Inc., Boston
(Contract W-31-109-eng-38)
(ANL/CNSV/TM-36) Avail: NTIS HC A06/MF A01

The possibility that a district heating system, based on thermal energy from power plants retrofitted to operate in the cogeneration mode can improve local air quality was investigated by comparing the emissions of five major atmospheric pollutants from the existing heating and electric system in the City of Boston with those from a proposed district heating system. The methodology, the results and their implications, and the areas for extended investigation are described. The initial results confirm expectations. Average sulfur oxides concentrations at various points within and near the city drop by up to 85% in the existing fuels scenarios and by 95% in scenarios in which different fuels and more stringent emissions controls at the plants are used. These reductions are relative to concentrations caused by fuel combustion for heating and large commercial and industrial process uses within the city and Boston Edison Co. electric generation. DOE

N81-11572# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
INDOOR AIR-QUALITY MEASUREMENTS IN ENERGY-EFFICIENT RESIDENTIAL BUILDINGS
James V. Berk, Craig D. Hollowell, James H. Pepper, and Rodger Young May 1980 50 p refs Presented at the 72d Ann. Air Pollution Control Assoc. Meeting, Cincinnati, 24 Jun. 1979
(Contract W-7405-eng-48)
(LBL-8894-Rev; EED-Vent-80-8; CONF-790634-4-Rev) Avail:

NTIS HC A03/MF A01

The potential impact on indoor air quality of energy conserving measures that reduce ventilation was assessed. Using a mobile laboratory, on-site monitoring of infiltration rate, carbon dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, ozone, sulfur dioxide, formaldehyde, total aldehydes, and particulates was conducted in three houses designed to be energy efficient. Preliminary results show that energy conserving design features that reduce air exchange rates compromise indoor air quality; specifically, indoor levels of several pollutants were found to exceed levels detected outdoors. Although the indoor levels of most pollutants are within limits established by present outdoor air quality standards, considerable work remains to be accomplished before health risk effects can be accurately assessed. DOE

N81-11573# Argonne National Lab., Ill.

ENVIRONMENTAL CONTROL TECHNOLOGY SURVEY OF SELECTED UNITED STATES STRIP MINING SITES. VOLUME 2B: ALABAMA. WATER QUALITY IMPACTS AND OVERBURDEN CHEMISTRY OF ALABAMA STUDY SITE Technical Report, May 1976 - Jul. 1977

J. D. Hendricks, J. E. Bogner, R. D. Olsen, J. P. Schubert, A. A. Sobek, and D. O. Johnson May 1980 112 p refs

(ANL/EMR-2-Vol-2B) Avail: NTIS HC A06/MF A01

An intensive study of water, coal, and overburden chemistry was conducted at a surface coal mine in Alabama from May 1976 through July 1977. Sampling sites included the pit sump, a stream downgrade from the mine, the discharge from the water treatment facility, and a small stream outside the mine drainage. Water samples were collected every two weeks and analysed for the following parameters: specific conductance, pH, temperature, acidity, bicarbonate, carbonate, chloride, total dissolved solids, suspended solids, sulfate, and 20 metals. No potential acid problem exists at this mine. Water quality is good in both streams sampled, and high levels of dissolved elements are found only in water collected from the pit sump. The mine effluent is in compliance with Office of Surface Mining water quality standards. DOE

N81-11574# Atomic Industrial Forum, Inc., Washington, D. C.

ATMOSPHERIC AND TERRESTRIAL EFFECTS OF CLOSED-CYCLE COOLING SYSTEMS: AN ANNOTATED BIBLIOGRAPHY Interim Report, Jun. 1980

S. L. Nakamura and N. S. Dailey Jun. 1980 163 p Sponsored in part by ORNL, Tenn.

(Contract W-7405-eng-26)

(EPRI-EA-1438) Avail: NTIS HC A08/MF A01

Almost 600 references dealing with the environmental impacts of closed-cycle cooling systems were extracted from the open literature for the period up to the spring of 1979 and from environmental reports and impact statements prepared for or by the electric utility industry. Topics covered include atmospheric discharges from cooling towers, predicted cumulative effects of releases from energy park, sensitivity of agricultural crops and native vegetation, salt deposition, aesthetic impacts, atmospheric dispersion and plume behavior, analytical methods and mathematical models and studies to assess the effects of closed-cycle cooling operations. Entries are arranged by subject category and indexes are provided to authors names, energy facility names and geographic location of field research. DOE

N81-11575# Argonne National Lab., Ill. Energy and Environmental Systems Div.

ENVIRONMENTAL ASSESSMENT OF A PROGRAM TO REDUCE OIL AND GAS CONSUMPTION BY ELECTRIC UTILITIES

Mar. 1980 117 p refs

(Contract W-31-109-eng-38)

(ANL/EES/TM-97) Avail: NTIS HC A06/MF A01

An environmental assessment is presented of a program aimed at reducing oil and gas consumption in electric utility power plants by the equivalent of approximately 1,000,000 barrels per day by 1990. The program would mandate the conversion of 45 power plants (approximately 21 GW) to coal and would provide financial incentives for the accelerated replacement of other existing oil and gas fired plants (estimated to be 30 GW) by new coal fired plants or other acceptable alternatives. The air quality impacts of potential increases in sulfur dioxide, nitrogen oxides, and particulate matter emissions associated with the program are analyzed. Potential solid waste, coal production and transportation, and public health and welfare impacts are also considered. Impacts at the national and regional levels, with some discussion of possible local air quality effects of conversion of specific plants are presented. DOE

N81-11576# Lovelace Biomedical and Environmental Research Inst., Albuquerque, N. Mex. Inhalation Toxicology Research Inst.

DIESEL EXHAUST EMISSIONS TOXICOLOGY PROGRAM Status Report, Jan. 1980

Roger O. McClellan, ed. Mar. 1980 43 p ref

(Contract DE-AC04-76EV-01013; EY-76-C-04-1013)

(LMF-73) Avail: NTIS HC A03/MF A01

The current status of the Department of Energy's research programs to assess the the environmental accaptability of diesel engines is reviewed. Activities in the inter-related areas are reviewed: (1) studies to establish the physical, chemical, and biological characteristics of emission from different vehicles over a range of operating conditions, fuel types and control devices; (2) evaluations to predict the transport and transformation of diesel exhaust as it moves from vehicles to the breathing zone of man; (3) research to predict the inhalation, deposition, retention and fate in the body of diesel exhaust particles and the organic compounds that are an integral part of the particles; (4) chronic exposure of laboratory animals to graded levels of diesel exhaust to determine the potential of these exposures for causing cancer or functional disorders, especially the respiratory tract, over the lifetime of the animals; and (5) development of an integrated risk assessment that brings together all relevant information to predict emission, exposure atmospheres, effective dose to critical tissues, and health effects in man for various scenarios of diesel vehicle production and deployment. DOE

N81-11577# Los Alamos Scientific Lab., N. Mex. Modeling and Economic Analysis Group (S-2).

AIR QUALITY REGULATION IN SPATIAL EQUILIBRIUM MODELS

Charles D. Kolstad 1980 27 p refs Presented at 5th Intern. Clean Air Congr., Buenos Aires, 20-26 Oct. 1980

(Contract W-7405-eng-37)

(LA-UR-80-1753; CONF-801015-1) Avail: NTIS HC A03/MF A01

Methods for including a wide variety of air pollution regulations within the class of economic equilibrium models where allocation is based on constrained optimization is presented. The first part of the paper discusses current air pollution regulation in the United States and possible future regulation. A prototype spatial equilibrium model within which a number of regulatory mechanisms are explicitly represented is also described. These include efficient and zoned charges, statically and dynamically efficient permit systems, technological control and hybrid permit charge systems. DOE

N81-11578# Syracuse Research Corp., N. Y. Center for Chemical Hazard Assessment.

REVIEWS OF THE ENVIRONMENTAL EFFECTS OF POLLUTANTS. 10: TOXAPHENE

Patrick R. Durkin, Philip H. Howard, Jitendra Saxena, Sheldon S. Lande, Joseph Santodonato, John R. Strange, Deborah H. Christopher, and William B. Buck (Illinois Univ., Urbana) Cincinnati EPA Sep. 1980 500 p refs

(Contract W-7405-eng-26)

(ORNL/EIS-130; EPA-600/1-79-044) Avail: NTIS HC A21/MF A01

The environmental effects of toxaphene are extensively reviewed. Information is presented on chemical properties and analytical techniques, environmental occurrence, cycling, and fate, as well as on food chain interactions. Biological aspects of toxaphene in microorganisms, plants, wild and domestic animals, and humans and test animals are reviewed, including metabolism, toxicity, carcinogenicity, mutagenicity, and teratogenicity. DOE

N81-11579# Lovelace Biomedical and Environmental Research Inst., Albuquerque, N. Mex. Inhalation Toxicology Research Inst.

LOW Btu GASIFIER EMISSIONS TOXICOLOGY PROGRAM Status Report, Oct. 1979
George J. Newton, ed. Oct. 1979 47 p refs
(Contract DE-AC04-76EV-01013; EY-76-C-04-1013)
(LMF-75) Avail: NTIS HC A03/MF A01

Results to date from the physical, chemical, and biological characterization of potential toxicants in liquid, solid, and gaseous process streams of an experimental low Btu gasifier are summarized. These results were obtained with a limited data base for a small experimental gasifier. DOE

N81-11580# Oak Ridge National Lab., Tenn. Energy Div.
ENVIRONMENTAL AND HEALTH ASPECTS OF BIOMASS ENERGY SYSTEMS
H. M. Braunstein and F. C. Kornegay 1980 8 p refs Presented at the 180th ACS Meeting, San Francisco, 24 Aug. 1980
(Contract W-7405-eng-26)
(CONF-800814-11) Avail: NTIS HC A02/MF A01

Production of biomass as well as conversion can lead to environmental impact, and although most impacts will be site specific, some generic effects can be identified. Since biomass-related impacts cover a very broad spectrum of materials, processes, end products, and effects, the discussion presented here, except for an overview of generic effects and comment on production impacts, is directed primarily to those resulting from residential wood combustion. DOE

N81-11581# Battelle Pacific Northwest Labs., Richland, Wash.
HYBRID REGIONAL AIR POLLUTION MODELS
Ronald L. Drake Mar. 1980 34 p refs Presented at the Workshop on Regional Air Pollution Modeling, Port Deposit, Md., 29 Oct. - 1 Nov. 1979
(Contract DE-AC06-76RL-01830)
(PNL-SA-8431; CONF-7910183-1) Avail: NTIS HC A03/MF A01

A family of air quality models for predicting and analyzing the fine particulate loading in the atmosphere, for assessing the extent and degree of visibility impairment, and for determining the potential of pollutants for increasing the acidity of soils and water is discussed. The major horizontal scales of interest are from 400 km to 2000 km; and the time scales may vary from several hours, to days, weeks, and a few months or years, depending on the EPA regulations being addressed. The role air quality models play in the general family of atmospheric simulation models is described. The characteristics of a well designed, comprehensive air quality model are discussed. A list of hybrid models that are currently in use are given. The PNL regional transport model is also outlined and a number of research needs are listed. DOE

N81-11582# California Univ., Davis. Dept. of Mathematics.
ELECTROSTATIC FIBROUS AIR FILTERS, A THEORETICAL STUDY Final Report
Dallas O. Banks and Russell A. Boyles Sep. 1979 84 p refs
(Contract W-7405-eng-48)
(UCRL-15137) Avail: NTIS HC A05/MF A01

A model of fibrous air filters is given which accounts for the inhomogeneity of the filter by assuming that the packing density and the fiber radius are random variables. Using the cell models of Happel and Kuwabara, a form of Darcy's Law for the pressure drop was derived in terms of appropriate averages of the local permeability. The resulting local mean velocity was then used to get formulas for the particle penetration through the filter. The influence of diffusion in the case of flow parallel to the filter fibers was investigated. A means of computing the single fiber efficiency in the case of externally electrified air filters is presented. DOE

N81-11583# Georgia Univ., Athens. Inst. of Ecology.
RAINFALL ELEMENT CONTENT AND ACIDITY FROM 30 APRIL 1976 TO 17 FEBRUARY 1978, ATHENS, GEORGIA
B. L. Haines, J. V. Nabholz, and S. DuBois 1 Aug. 1980 23 p refs
(Contract DE-AS09-76EV-00641; Grant NSF DEB-76-19930; Grant EPA-R-80530-5010)
(DOE/EV-00641/42) Avail: NTIS HC A02/MF A01

Precipitation from 99 storm events had pH values ranging from 3.2 to 4.8 with median pH of 4.1. Rainfall with a pH lower than 5.6 resulting from equilibration of pure water with atmospheric CO2 at 25 C can be termed acid rain. The volume weighted average rainfall in north Georgia is acid rain. Comparison of volume weighted pH values from Athens with values from Coweeta, North Carolina and Gatlinburg, Tennessee, suggest that acid rain is a regional problem in the Southeast. DOE

N81-11584# Environmental Research and Technology, Inc., Westlake Village, Calif.
DEVELOPMENT OF A PARTICULATE SULFATE ANALYZER Final Report
P. K. Mueller and J. F. Collins Aug. 1980 143 p refs
(EPRI Proj. 678-1)
(EPRI-EA-1492) Avail: NTIS HC A07/MF A01

Of two commercially available flame photometric sulfur gas analyzers selected as candidates for modification, one was modified into the MERT 285 particulate sulfate analyzer in which sulfur gases are removed from the aerosol being sampled as they flow through a silver oxide based diffusion denuder. The FPD signal is then integrated to provide readings down to 0.1 micron gram/SO4/cum. The response of the MERT 285 per sulfur atom is essentially equal for H2SO4, (NH4)2SO4, MgSO4 and SO2. In ambient air tests, lower quantifiable limits of about 5 micron g SO4/cum were achieved. The performance of the MERT 285 under air quality sampling conditions compares favorably with the performance of continuous sulfate analyzers concurrently being developed by other researchers. Three hour averaged responses of the MERT 285 agreed with 3 hour filter sampled sulfate values and yielded a correlation coefficient of 0.97. DOE

N81-11585# Brookhaven National Lab., Upton, N. Y.
ACID PRECIPITATION AND THE AQUATIC ENVIRONMENT
George R. Hendrey and Frederick W. Lipfert 28 May 1980 24 p refs
(Contract DE-AC02-76CH-00016)
(BNL-28173) Avail: NTIS HC A02/MF A01

A review is presented of the problem of acid rain in the eastern United States. The historical development of acid rain, its causes and the mechanisms of its formation, and its impact on aquatic ecosystems are discussed. DOE

N81-11586# Argonne National Lab., Ill. Energy and Environmental Systems Div.
COSTS AND WATER QUALITY EFFECTS OF WASTEWATER TREATMENT PLANT CENTRALIZATION
C. M. Macal and B. J. Broomfield Jan. 1980 21 p refs Prepared in cooperation with Chicago Univ., Ill. Sponsored in part by NSF
(Contract W-31-103-eng-38)
(ANL/ES-98) Avail: NTIS HC A02/MF A01

The costs and water quality impacts of two regional configurations of municipal wastewater treatment plants in northeastern Illinois are compared. In one configuration, several small treatment plants are consolidated into a smaller number of regional facilities. In the other, the smaller plants continue to operate. Costs for modifying the plants to obtain various levels of pollutant removal are estimated using a simulation model that considers the type of equipment existing at the plants and the costs of modifying that equipment to obtain a range of effluent levels for various pollutants. A dynamic water quality hydrology simulation model is used to determine the water quality effects of the various treatment technologies and pollutant levels. Cost and water quality data are combined and the cost effectiveness of the two treatment configurations is compared. The regionalized treatment plant configuration is found to be the more cost effective. DOE

N81-11587# Versar, Inc., Springfield, Va.
WATER-RELATED ENVIRONMENTAL FATE OF 129 PRIORITY POLLUTANTS. VOLUME 1: INTRODUCTION AND TECHNICAL BACKGROUND, METALS AND INORGANICS, PESTICIDES AND PCBS Final Report
Michael A. Callahan, Michael W. Slimak, Norman W. Gabel, Ira P. May, Charles F. Fowler, J. Randall Freed, Patricia Jennings, Robert L. Durfree, Frank C. Whitmore, Bruno Mestri et al Dec.

1979 388 p refs Prepared in cooperation with SRI International, Menlo Park, Calif. 2 Vol.
(Grants EPA-68-01-3852; EPA-68-01-3867)
(PB80-204373; EPA-440/4-79-029A-Vol-1) Avail: NTIS HC A17/MF A01 CSCL 13B

A summary of relevant data is given for the individual fate processes (hydrolysis, biodegradation, photolysis, etc.) which might be expected to occur if a pollutant were introduced into an aquatic system. The approach taken is to summarize data on the individual processes which might be important in describing the transport and fate of pollutants introduced at low concentrations (e.g., ppm or less) into aquatic environments. If transport processes will result in significant pollutant transfer to another medium (e.g., air, sediments), data are included where available to describe what happens to the pollutant in the medium to which the pollutant was transferred. Results of the literature search are that a significant amount of information on most pollutants was found, but that the information was more useful in making qualitative judgments about the pollutant transport and fate than for making quantitative predictions of concentrations in the environment. GRA

N81-11588# Versar, Inc., Springfield, Va.
WATER-RELATED ENVIRONMENTAL FATE OF 129 PRIORITY POLLUTANTS. VOLUME 2: HALOGENATED ALIPHATIC HYDROCARBONS, HALOGENATED ETHERS, MONOCYCLIC AROMATICS, PHTHALATE ESTERS, POLYCYCLIC AROMATIC HYDROCARBONS, NITROSAMINES AND MISCELLANEOUS COMPOUNDS Final Report
Michael A. Callahan, Michael W. Slimak, Norman W. Gabel, Ira P. May, Charles F. Fowler, J. Randall Freed, Patricia Jennings, Robert L. Durfee, Frank C. Whitmore, Bruno Maestri et al Dec. 1979 673 p refs Prepared in cooperation with SRI International, Menlo Park, Calif. 2 Vol.
(Grants EPA-68-01-3852; EPA-68-01-3867)
(PB80-204381; EPA-440/4-79-029B-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 13B

A summary of relevant data for the individual fate processes (hydrolysis, biodegradation, photolysis, etc.) which might be expected to occur if a pollutant were introduced into an aquatic system is presented. The report is organized into 101 individual chapters for pollutants or small groups of pollutants, and four introductory chapters. Each chapter has its own references so the chapters can be used independently. GRA

N81-11589# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
LASER-RAMAN POINT MONITORING OF CH4 VAPOR IN THE LNG STORAGE FIELD Final Report, 1 Jan. - 31 Dec. 1979
Richard K. Chang and Robert E. Benner Dec. 1979 39 p Sponsored by Gas Research Inst.
(PB80-205347; GRI-79/0050) Avail: NTIS HC A03/MF A01 CSCL 07D

Use of an eight component hydrocarbon gas which simulated the contents of natural gas demonstrated that unique Raman signatures for each species exist and real time Raman monitoring of each species is possible by detection with an optical multichannel analyzer which can measure simultaneously a large portion of the Raman spectrum. The feasibility of using optical fibers to guide the laser radiation to a remote probe site and to collect/guide the Raman scattered radiation back to the detection system was investigated. GRA

N81-11590# Environmental Monitoring and Support Lab., Research Triangle Park, N. C.
AMBIENT AIR MONITORING FOR BENZENE. 24 HOUR INTEGRATED SAMPLING IN SIX CITIES Final Report, 1 Jun. 1977 - 1 Apr. 1980
Barry E. Martin, Thomas Clark, Joseph Bumgarner, and Gary F. Evans May 1980 41 p refs
(PB80-205859; EPA-600/4-80-027) Avail: NTIS HC A03/MF A01 CSCL 07D

The population exposure to ambient levels of benzene was assessed in conjunction with the announcement of benzene as a hazardous material. During the summer and fall of 1977, average benzene concentrations of 5, 18, and 19 microgram/cu in, respectively, were measured in the widely separated cities of Dallas, Chicago, and Los Angeles. The precision of these data is estimated to be + or - 26 percent of the measured values. The improvement of benzene monitoring and analysis technology was an important secondary objective of this program. Further research is needed to identify a more favorable collection medium than the Tenex that was used in this study. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N81-11591 Stanford Univ., Calif.
A BAYESIAN GEOPHYSICAL MODEL FOR SEISMIC HAZARD Ph.D. Thesis
Martin William McCann, Jr. 1980 339 p
Avail: Univ. Microfilms Order No. 8024709

Seismic hazard analysis is concerned with defining the expected future hazard due to earthquakes. The problem of modeling the ground shaking intensity given the occurrence of a seismic event is addressed. A method for defining strong motion duration of recorded earthquake shaking is developed based on the rate of change of the root mean square (rms) acceleration as a function of time. The Bayesian model developed is designed to expand the modeling capability of the seismic hazard analyst. The model consists of two parts; the prior knowledge about ground motion as derived from empirical studies, and additional information that can be provided by theoretical models to provide a likelihood function. Results of the method are presented for the Imperial Valley region of southern California. The theoretical model is used in a deterministic manner to model past events and in a probabilistic setting for postulated future earthquakes. Dissert. Abstr.

N81-11592*# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
STUDIES OF AURORAL X-RAY IMAGING FROM HIGH ALTITUDE SPACECRAFT Final Report
D. L. McKenzie, P. F. Mizera, and C. J. Rice 27 Jun. 1980 83 p refs
(Contract NASw-3338)
(NASA-CR-163702) Avail: NTIS HC A05/MF A01 CSCL 04A

Results of a study of techniques for imaging the aurora from a high altitude satellite at X-ray wavelengths are summarized. The X-ray observations allow the straightforward derivation of the primary auroral X-ray spectrum and can be made at all local times, day and night. Five candidate imaging systems are identified: X-ray telescope, multiple pinhole camera, coded aperture, rastered collimator, and imaging collimator. Examples of each are specified, subject to common weight and size limits which allow them to be intercompared. The imaging ability of each system is tested using a wide variety of sample spectra which are based on previous satellite observations. The study shows that the pinhole camera and coded aperture are both good auroral imaging systems. The two collimated detectors are significantly less sensitive. The X-ray telescope provides better image quality than the other systems in almost all cases, but a limitation to energies below about 4 keV prevents this system from providing the spectra data essential to deriving electron spectra, energy input to the atmosphere, and atmospheric densities and conductivities. The orbit selection requires a tradeoff between spatial resolution and duty cycle. Author

N81-11593*# Ohio State Univ., Columbus. Dept. of Geodetic Sciences.
A VLBI VARIANCE-COVARIANCE ANALYSIS INTERACTIVE COMPUTER PROGRAM M.S. Thesis
Yehuda Bock May 1980 100 p refs
(Grant NSG-5265; OSURF Proj. 711055)
(NASA-CR-163733; DGS-298) Avail: NTIS HC A05/MF A01 CSCL 08G

An interactive computer program (in FORTRAN) for the variance covariance analysis of VLBI experiments is presented

for use in experiment planning, simulation studies and optimal design problems. The interactive mode is especially suited to these types of analyses providing ease of operation as well as savings in time and cost. The geodetic parameters include baseline vector parameters and variations in polar motion and Earth rotation. A discussion of the theroy on which the program is based provides an overview of the VLBI process emphasizing the areas of interest to geodesy. Special emphasis is placed on the problem of determining correlations between simultaneous observations from a network of stations. A model suitable for covariance analyses is presented. Suggestions towards developing optimal observation schedules are included. Author

N81-11594*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.

FEASIBILITY OF QUASI-RANDOM BAND MODEL IN EVALUATING ATMOSPHERIC RADIANCE Final Report, period ending 30 Jun. 1980

S. N. Tiwari and Navin Mirakhur Aug. 1980 76 p refs
(Grant NsG-1522)
(NASA-CR-163707) Avail: NTIS HC A05/MF A01 CSCL 04A

The use of the quasi-random band model in evaluating upwelling atmospheric radiation is investigated. The spectral transmittance and total band adsorptance are evaluated for selected molecular bands by using the line by line model, quasi-random band model, exponential sum fit method, and empirical correlations, and these are compared with the available experimental results. The atmospheric transmittance and upwelling radiance were calculated by using the line by line and quasi random band models and were compared with the results of an existing program called LOWTRAN. The results obtained by the exponential sum fit and empirical relations were not in good agreement with experimental results and their use cannot be justified for atmospheric studies. The line by line model was found to be the best model for atmospheric applications, but it is not practical because of high computational costs. The results of the quasi random band model compare well with the line by line and experimental results. The use of the quasi random band model is recommended for evaluation of the atmospheric radiation. Author

N81-11595*# California Inst. of Tech., Pasadena.

FUNDAMENTAL STUDIES IN GEODYNAMICS Final Technical Report

Don L. Anderson 31 Jul. 1980 301 p refs
(Grant NsG-7610)
(NASA-CR-163734) Avail: NTIS HC A14/MF A01 CSCL 08G

Progress in modeling instantaneous plate kinematics is reviewed, with emphasis on recently developed models of present day plate motions derived by the systematic inversion of globally distributed data sets. Rivera plate motions, the Caribbean South American boundary, Indian plate deformation, Pacific-North America, seismicity and subduction processes, and the study of slow earthquakes and free oscillations are discussed. L.F.M.

N81-11596*# California Inst. of Tech., Pasadena. Geological and Planetary Sciences Div.

AN AIRBORNE SYSTEM FOR DETECTION OF VOLCANIC SURFACE DEFORMATIONS

Jonathan Lunine 20 Aug. 1980 21 p refs Sponsored by NASA Prepared for Lunar and Planetary Inst., Houston, Tex.
Avail: NTIS HC A02/MF A01 CSCL 08K

A technique is proposed for measuring volcanic deformation on the order of centimeters per day to centimeters per year. An airborne multifrequency pulsed radar, tracking passive ground reflectors spaced at 1 kilometer intervals over a 50 square kilometer area is employed. Identification of targets is accomplished by Doppler and range resolution techniques, with final relative position measurements accomplished by phase comparison of multifrequency signals. Atmospheric path length errors are corrected by an airborne refractometer, meteorological instruments, or other refractive index measuring devices. Anticipated system accuracy is 1-2 cm, with measuring times on the order of minutes. Potential problems exist in the high intrinsic data assimilation rate required of the system to overcome ground backscatter noise. S.F.

N81-11597# Pontificia Univ. Javeriana, Bogota (Colombia). Instituto Geofisico de los Andes Colombianos.

COLOMBIAN EARTHQUAKES OF 23 NOVEMBER AND 12 DECEMBER 1979 [TERREMOTOS COLOMBIANOS NOVIEMBRE 23 Y DICIEMBRE 12 DE 1979]

Jesus Emilio Ramirez and Jose Rafael Goberna 1980 97 p In SPANISH
Avail: NTIS HC A05/MF A01

The earthquake of November 23 and the earthquake and tsunami of December 12 are discussed in terms of the regional geology, the characteristics of the tremors, and the damages. Probable causes of these earthquakes are reviewed. Recommendations are made concerning reinforcement of existing buildings and future construction in the fault zones. E.D.K.

N81-11598# ENSCO, Inc., Alexandria, Va. Applied Research Div.

INTERACTIVE AND AUTOMATIC MODES OF LONG-PERIOD SIGNAL EXTRACTION USING CASCADED FILTERS

Alan C. Strauss 10 Dec. 1979 72 p refs
(Contract F08606-79-C-0014; ARPA Order 2551)
(AD-A089994; SAR(01)-TR-79-05; TR-5) Avail: NTIS HC A04/MF A01 CSCL 17/10

The purpose of this work was to develop and evaluate an interactive long-period signal extraction filter suite. Five filters were included in the suite and were applied to test data in a cascaded mode, (i.e., the output of one filter served as the input to the next filter). The filters tested were a bandpass filter, a Wiener filter, a chirp matched filter, a polarization filter, and a Gaussian narrowband filter. It was found that, for the filters examined, the polarization filter dominates the cascaded filtering approach to signal extraction; specifically, processing gains as high as 14 to 15 dB were realized from the application of cascaded filters which included this filter. Further, tests performed on a Eurasian data set using one specific cascaded filter sequence yielded an improvement in surface wave detection capability equivalent to an improvement in bodywave detectability of approximately 0.6 to 0.8 m sub b units. Finally, cascaded filters were found to provide more detected signals from which surface wave magnitudes can be obtained; as such, the use of these filters can enhance an analyst's capability to discriminate between earthquakes and explosions. GRA

N81-11599# California Inst. of Tech., Pasadena. Seismological Lab.

BODY AND SURFACE WAVE MODELING OF OBSERVED SEISMIC EVENTS Semiannual Technical Report, 1 Oct. 1979 - 31 Mar. 1980

David G. Harkrider, Donald V. Helmberger, and J. Bernard Minster Sep. 1980 130 p refs
(Contract F49620-77-C-0022; ARPA Order 3291)
(AD-A089710; AFOSR-80-0872TR) Avail: NTIS HC A07/MF A01 CSCL 08/11

The research performed under this contract during the period 1 October through 31 March 1980 can be divided into three main topics, excitation of surface waves from complex source regions, modeling of P sub n to PL waves for source inversion and determining earthquake source characteristics using synthetic teleseismic long period body and surface waves. In Section 2 preliminary results are presented which show the feasibility of using the representation theorem to investigate the excitation of surface waves due to complicated sources in complex source regions. In Section 3, it is shown that a simple one-layer crust mantle structure is adequate to model P sub n to PL waves at ranges 1 to 12 degrees for most of the western U.S. Section 5 concerns the use of synthetic long period body and surface waves to determine the depth, dimensions, and moment of the 1976 Friuli, Italy earthquake and its principal aftershock. GRA

N81-11600# Boston Coll., Chestnut Hill, Mass. Dept. of Physics.

PHENOMENOLOGICAL AND THEORETICAL STUDIES ON MAGNETIC INDICATORS OF SUBSTORM ACTIVITY Final Report, 3 Dec. 1976 - 30 Sep. 1979

Robert L. Carovillano, Robert E. Sheehan, George L. Siscoe, Richard W. Nopper, Jr., Joseph N. Barfield, M. S. Gussenhoven-Shae, Michael Heinemann, Nancy V. Crooker, Robert H. Eather,

and William J. Burke 21 Mar. 1980 166 p refs
(Contract F19628-77-C-0085; AF Proj. 7601)
(AD-A090017; AFGL-80-0094TR) Avail: NTIS HC A08/MF A01 CSCL 08/14

We report results of studies made on substorm detection, behavior, and relationship to magnetospheric processes. A scheme is developed whereby sub auroral or mid latitude magnetometer stations may be used to detect substorm occurrence. Factors limiting detection quality include longitudinal station coverage, substorm intensity, and local time dependence. Test results from mid latitude stations located in the night sector indicate 100% detection of AE events that exceed 600 gamma and 50% if AE exceeds 200 gamma, and less sensitivity for dayside detection. The AFGL magnetometer chain would give improved detection capability and reliability, in real time. A literature review is given on micropulsations as indicators of geomagnetic activity and recommendations made for utilizing the AFGL chain in this regard. Field aligned currents drive ionospheric current systems on a global scale. A model is developed to describe this process for quiet and disturbed conditions. Determination of the ground magnetic signature from an ionospheric current distribution is not unique and requires specification of image currents and ionospheric closure currents. GRA

N81-11601# SRI International Corp., Menlo Park, Calif.
THE GROWTH AND DECAY OF EQUATORIAL BACKSCATTER PLUMES Topical Report, 1 Jul. - 1 Oct. 1979
Roland T. Tsunoda 1 Feb. 1980 55 p refs
(Contract DNA001-79-C-0153)
(AD-A090048; DNA-5249T) Avail: NTIS HC A04/MF A01 CSCL 04/1

During the past three years, a series of rocket experiments from the Kwajalein Atoll, Marshall Islands, were conducted to investigate the character of intense, scintillation-producing irregularities that occur in the nighttime equatorial ionosphere. Because the source mechanism of equatorial irregularities, believed to be the Rayleigh-Taylor instability, is analogous to that which generates plasma-density striations in a nuclear-induced environment, there is considerable interest in the underlying physics that controls the characteristics of these irregularities. A primary objective of ALTAIR investigations of equatorial irregularities is to seek an understanding of the underlying physics by establishing the relationship between meter-scale irregularities (detected by ALTAIR), and the large-scale plasma-density depletions (or 'bubbles') that contain the kilometer-scale, scintillation-producing irregularities. We describe the time evolution of backscatter 'plumes' produced by one meter equatorial field-aligned irregularities. Using ALTAIR, a fully steerable backscatter radar, to repeatedly map selected plumes, we characterize the dynamic behavior of plumes in terms of growth and a decay phase. Most of the observed characteristics are found to be consistent with equatorial-irregularity generation predicted by current theories of Rayleigh-Taylor and gradient-drift instabilities. However, other characteristics have been found that suggest key roles played by the eastward neutral wind and by altitude-modulation of the bottomside F layer in establishing the initial conditions for plume growth. GRA

N81-11602# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Snow and Ice Research Div.
FRACTURE BEHAVIOR OF ICE IN CHARPY IMPACT TESTING
Kazuhiko Itagaki and Richard L. Sabourin Jun. 1980 20 p refs
(DA Proj. 4A1-61102-AT-24)
(AD-A089920; CRREL-80-13) Avail: NTIS HC A02/MF A01 CSCL 08/12

Specimens prepared from various types of ice without introducing excessive defects were tested at temperatures ranging from -2 to -190 C. These tests indicated slightly higher Charpy values at lower temperatures and in more highly dispersed material concentrations. Three modes of fracture occurred during testing. Depending on the temperature and the material composition, either of the first two modes, normal fracture or multiple fracture, will appear and will show a normal frequency distribution of Charpy values in each type of ice. The third mode, fracture from both ends, which frequently occurred in the NH4F doped ice, gave Charpy values two to five times higher than the mean value for normal fracture. It can, therefore, be concluded that certain types of doping can alter the mode of fracture, through which drastic modifications of impact resistance may be possible. GRA

N81-11603# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
GREENLAND ICE SHEET PROGRAM
John Rand Jun. 1980 20 p refs
(AD-A089699; CRREL-SR-80-24) Avail: NTIS HC A02/MF A01 CSCL 08/12

A modified CRREL thermal drill was used at DYE-3 in Greenland to drill a 8.75 in. diameter hole 251 ft deep for the installation of a steel casing. This activity was accomplished by a drill team from CRREL in preparation for the Danish deep drill tests. Included in this report is a description of both the drilling and casing operation as well as a description of the equipment used. GRA

N81-11604# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
ICE ADHESION TESTS ON COATINGS SUBJECTED TO RAIN EROSION
David L. Minsk Jul. 1980 18 p refs
(AD-A089698; CRREL-80-28) Avail: NTIS HC A02/MF A01 CSCL 11/3

Screening tests to select icephobic coatings displaying low ice release forces, both before and after exposure to rain erosion in a whirling arm simulator, were performed on approximately 60 commercial materials. A unique linear ball-slide shear test apparatus was designed to provide pure shear forces. No coating survived the erosion test to give an interfacial shear strength as low as 15 psi (103 kPa), an arbitrarily established goal. Several coatings showed shear strengths between 30 and 45 psi (207 and 310 kPa) after rain erosion. GRA

N81-11605# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
APPLICATION OF NATURAL ELECTROMAGNETIC FIELD MAGNETIC FIELD METHODS (MAGNETOTELLURICS/GEOMAGNETIC VARIATIONS) TO EXPLORING FOR ENERGY RESOURCES: DEVELOPMENT OF A BROAD-BAND DATA ACQUISITION/PROCESSING FACILITY Topical Report, 1 May 1979 - 30 Apr. 1980
J. F. Hermance 1980 5 p refs
(Contract DE-AC02-79ER-10401)
(DOE/ER-10401/T1) Avail: NTIS HC A02/MF A01

A review of the present state of knowledge of the deep thermal regimes associated with major rift systems of the world is presented. Field studies of several major tectonomagnetic systems are described. A new magnetotelluric/geomagnetic variation field system for studying thermal regimes in the continental crust was designed and tested. DOE

N81-11606# California Univ., Livermore. Lawrence Livermore Lab.
DEVELOPMENT OF THE SEISMIC INPUT FOR USE IN THE SEISMIC SAFETY MARGINS RESEARCH PROGRAM
D. L. Bernreuter and D. H. Chung 29 Jan. 1980 9 p refs Presented at 7th World Conf. on Earthquake Eng., Istanbul, 8-13 Sep. 1980 Sponsored by the Turkish National Committee on Earthquake Engineering Submitted for publication Sponsored in part by U.S. Nuclear Regulatory Commission
(Contract W-7405-eng-48)
(UCRL-81944; CONF-800919-1) Avail: NTIS HC A02/MF A01

The overall systems approach being developed for the seismic safety margins research program are outlined. The features of the approach being taken to reduce the uncertainty in the seismic input for this program are discussed. These features include extensive use of expert opinion, earthquake rupture simulation studies, and the way in which the seismic hazard is incorporated into the overall systems analysis. Preliminary results are given for the Zion site which is the power plant chosen for analysis in phase one of the program. DOE

N81-11607# Research Triangle Inst., Research Triangle Park, N. C. Geosciences Dept.

COASTAL-INLAND SOLAR RADIATION DIFFERENCE STUDY Final Report
Walter D. Bach, Jr. and Fred M. Vukovitch 1980 261 p refs
(Contracts DE-AC02-77ET-20174; EG-77-C-02-4470)
(DOE/ET-20174/1) Avail: NTIS HC A12/MF A01

A six station sampling network was established in the coastal plain of southeastern North Carolina, where previous evidence indicated that the sea breeze circulation is almost a daily occurrence from late May through October. Three sites were located near the coast (coastal sites) to assess the insolation at the coast. A site was located in an area seldom affected by the sea breeze (about 100 km from the coast). Two additional sites, located between the coastal sites and the control site, were to be used to assess the transient impact of the sea breeze upon the insolation. Pyranometers were located at each site to measure the global insolation. Direct normal insolation measured by a pyrheliometer and ultraviolet radiation measured by uv radiometers were observed at the inland and coastal sites only. Data were collected during the calendar year 1978. The results of the study indicated that the global insolation had greater variability over the network during the summer season. During the summer, there was a systematic diurnal variation of the difference in global insolation between the inland and the coastal sites. DOE

N81-11608# Battelle Pacific Northwest Labs., Richland, Wash.
DISRUPTIVE EVENT ANALYSIS: VOLCANISM AND IGNEOUS INTRUSION
B. M. Crowe Aug. 1980 46 p refs
(Contract DE-AC06-76RL-01830)
(PNL-2882) Avail: NTIS HC A03/MF A01

An evaluation was made of the disruptive effects of volcanic activity with respect to long term isolation of radioactive waste through deep geologic storage. Three major questions were considered. First, what is the range of disruption effects of a radioactive waste repository by volcanic activity. Second, is it possible, by selective siting of a repository to reduce the risk of disruption by future volcanic activity. And third, can the probability of repository disruption by volcanic activity be quantified. The main variables involved in the evaluation of the consequences of repository disruption by volcanic activity were the geometry of the magma repository intersection (partly controlled by depth of burial) and the nature of volcanism. Simplified probability calculations were attempted for areas of past volcanic activity. DOE

N81-11609# California Univ., Livermore.
TREATMENT OF DYNAMICAL PROCESSES IN TWO DIMENSIONAL MODELS OF THE TROPOSPHERE AND STRATOSPHERE
Donald J. Wuebbles Jul. 1980 23 p refs
(Contract W-7405-eng-48)
(UCID-18771) Avail: NTIS HC A02/MF A01

Existing approaches to representing global atmospheric transport processes in two dimensional models are described and analyzed and possible alternatives to these approaches are discussed. A general description of the processes controlling the transport of trace constituents in the troposphere and stratosphere is given. DOE

N81-11610# California Univ., Livermore. Lawrence Livermore Lab.
LLNL EARTHQUAKE IMPACT ANALYSIS COMMITTEE REPORT ON THE LIVERMORE, CALIFORNIA EARTHQUAKES OF JANUARY 24 AND 26, 1980
15 Jul. 1980 109 p refs
(Contract W-7405-eng-48)
(UCRL-52956) Avail: NTIS HC A06/MF A01

The overall effects of the earthquakes of January 24 and 26, 1980, at the Lawrence Livermore National Laboratory in northern California are outlined. The damage caused by those earthquakes and how employees responded are discussed. The immediate emergency actions taken by management and the subsequent measure to resume operations are summarized. Long range plans for recovery and repair; and the seismic history of the Livermore Valley region, various investigations concerning the designbasis earthquake, and seismic criteria for structures are reviewed. Following an analysis of the Laboratory's earthquake preparedness, emergency response, and related matters a series of conclusions and recommendations are presented. DOE

N81-11611# Brookhaven National Lab., Upton, N. Y. Atmospheric Sciences Div.
ATMOSPHERIC BOUNDARY LAYER MEASUREMENTS DURING SUMMER MONEX 79 AT DIGHA, INDIA
S. SethuRaman, P. Michael, W. A. Tuthill, and J. McNeil Nov. 1979 37 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51149; UC-11; TID-4500) Avail: NTIS HC A03/MF A01

Marine boundary layer experiments conducted over the Bay of Bengal at Digha Beach, West Bengal, India, as part of the International Monsoon Experiments (MONEX 79) are described. The experiments consisted of measurements of atmospheric turbulence and fluxes of momentum, heat, and water vapor from a 10 m high coastal meteorological tower. Mean meteorological parameters were measured with an automated electronic weather station. Wind speed and direction profiles were obtained with pilot balloon soundings. Some typical tropical meteorological features photographed during the experiment are also presented. DOE

N81-11999*# Berry Coll., Mount Berry, Ga.
ON ROSEN'S THEORY OF GRAVITY AND COSMOLOGY
Ronnie C. Barnes *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 13 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 08F

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N81-11612*# Saint Louis Univ., Mo. Dept. of Earth and Atmospheric Sciences.
KINETIC ENERGY BUDGETS IN AREAS OF INTENSE CONVECTION Final Report
Henry E. Fuelberg, Emil M. Berecek, David M. Ebel, and Gary J. Jedlovec Washington Nov. 1980 186 p refs
(Contract NAS8-33370)
(NASA-CR-3336; M-305) Avail: NTIS HC A09/MF A01 CSCL 04B

A kinetic energy budget analysis of the AVE-SESAME 1 period which coincided with the deadly Red River Valley tornado outbreak is presented. Horizontal flux convergence was found to be the major kinetic energy source to the region, while cross contour destruction was the major sink. Kinetic energy transformations were dominated by processes related to strong jet intrusion into the severe storm area. A kinetic energy budget of the AVE 6 period also is presented. The effects of inherent rawinsonde data errors on widely used basic kinematic parameters, including velocity divergence, vorticity advection, and kinematic vertical motion are described. In addition, an error analysis was performed in terms of the kinetic energy budget equation. Results obtained from downward integration of the continuity equation to obtain kinematic values of vertical motion are described. This alternate procedure shows promising results in severe storm situations. T.M.

N81-11613# Air Force Global Weather Central, Offutt AFB, Nebraska.
THE USE OF SATELLITE-DERIVED SOUNDING IN THE AFGWC STRATOSPHERIC ANALYSIS MODELS
Fred P. Lewis, Terry C. Tarbell, and James E. Hoke 1 Aug. 1980 53 p refs
(AD-A090086; AFGWC/TN-80-003) Avail: NTIS HC A04/MF A01 CSCL 04/2

The first successful use of satellite-derived soundings in the stratospheric analysis models of the Air Force Global Weather Central (AFGWC) occurred on 26 December 1979. A new procedure for the construction of the stratospheric first-guess fields was also instituted on that date. These new first-guess

fields are based on satellite soundings. This Technical Note describes the changes that have been made to the stratospheric analysis procedure used at the AFGWC. GRA

N81-11614# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Lab.
HURRICANE SURGE STAGE-FREQUENCY ANALYSIS FOR DADE COUNTY, FLORIDA Final Technical Report, Jun. 1979 - Jun. 1980
Charles E. Abel Aug. 1980 59 p refs
(AD-A089735; WES-TR-HL-80-14) Avail: NTIS HC A04/MF A01 CSCL 08/3

A numerical investigation of the hurricane surge stage-frequency relationship has been performed for a 14.3 mile section of the Atlantic coast of Dade County, Florida. An idealized coast was used to represent current improvements to erosion and hurricane protection structures being supervised by the U.S. Army Engineer District, Jacksonville. The vertically integrated equations of motion are solved, using the formalism of the orthogonal curvilinear numerical open-coast surge model, SSURGE 3. This model includes Coriolis effects, surface wind stress, bottom frictional stress, and the 'inverted barometer' effect, but omits the nonlinear convective acceleration terms. GRA

N81-11615# Air Force Geophysics Lab., Hanscom AFB, Mass.
LOCAL FORECASTING THROUGH EXTRAPOLATION OF GOES IMAGERY PATTERNS Interim Report
Stuart H. Muench 23 Sep. 1980 8 p refs Presented at the 8th Conf. of Forecasting and Analysis, Denver, 10-13 Jun. 1980
(AF Proj. 6670)
(AD-A089701; AFGL-TR-80-0273) Avail: NTIS HC A02/MF A01 CSCL 04/2

An attractive approach to short-range forecasting is to determine cloud motion from a sequence of satellite images and extrapolate the patterns and associated weather into the future. Objective motion vector techniques are available and the forecast procedure can be accomplished by computer. This approach is being evaluated at AFGL and this report presents results of testing motion vector techniques. Tracking and covariance techniques were compared along with winds aloft and persistence (no motion) as controls. A covariance technique had top score, but only slightly better than persistence. Complicating factors and implications to forecasting are discussed. GRA

N81-11616# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
DIGITAL IMAGING RESEARCH FOR METEOROLOGICAL APPLICATIONS Final Report, 1 Sep. 1976 - 21 Jul. 1979
Thomas A. Brubaker, Gregory C. Smith, and Marvin Brown 19 Aug. 1980 184 p refs Revised
(Grant DAAG29-76-G-0324)
(AD-A090234; ARO-13971.7-GS) Avail: NTIS HC A05/MF A01 CSCL 04/2

Planning for this joint research on digital imaging by electrical engineers and atmospheric scientists begun in early 1976. At that time the use ofdigital solid state memory under small computer control to refresh a CRT to produce a 'digital image' was in its infancy. The research focused on the design, procurement, test, demonstration and meteorological research use of the new system. It was very successful and has received national and international acclaim. This Final Report includes complete details of the research on both hardware and software aspects of the system. This research has already led to the design and research use of the next generation of digital imaging systems. GRA

N81-11617# Sandia Labs., Albuquerque, N. Mex.
METEOROLOGICAL AND AIR QUALITY DATA. WIPP SITE: EDDY COUNTY, NEW MEXICO Quarterly Progress Report, Jun. - Aug. 1977
L. P. Pocalujka, E. Babit, P. A. Catizone, and H. W. Church Jun. 1980 26 p refs Prepared in cooperation with TRC Environmental Consultants, Wethersfield, Conn.
(Contract DE-AC04-76DP-00789)
(SAND-80-7107) Avail: NTIS HC A03/MF A01

The purpose of the WIPP meteorological, air quality, and radiological measurements program was to support the environmental effect for the evaluation of the site suitability. This data report is the latest in a series of seasonal quarterly data summaries to be issued for the southeastern New Mexico site. DOE

N81-11618# Sandia Labs., Albuquerque, N. Mex. Div. 1521.
LEW-2: A MINICOMPUTER CONTROLLED LIGHTNING EARLY WARNING SYSTEM
William W. Shurtleff 1980 13 p refs Presented at the 19th DOD Explosives Safety Seminar, Los Angeles, 9 Sep. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-1839C; CONF-800941-1) Avail: NTIS HC A02/MF A01

One of the problems with open air testing using explosives is that a high static charge or nearby lightning strike has the possibility of prematurely igniting the explosives. A system (LEW-2) which takes data from a matrix of potential gradient sensors and rebroadcasts this information to test operation using explosives was developed. This system gives early warning of possible hazards and allows safe storage of explosive materials. The LEW-2 system and its use as a hazard warning and weather data collection system are described. DOE

N81-11983*# Alabama Univ. in Huntsville. Dept. of Mathematics.
STATISTICAL WIND PROFILE GUST MODEL
Deva C. Doss *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 9 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 04B

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N81-11619 Washington Univ., St. Louis, Mo.
THE STRUCTURE AND VARIABILITY OF THE ATLANTIC NORTH EQUATORIAL COUNTERCURRENT DURING GATE: AUG. - SEP. 1974 Ph.D. Thesis
Carl Allen Paul 1980 166 p
Avail: Univ. Microfilms Order No. 8026289

The availability of moored current meter data from three principal moorings which were part of the GATE C-scale oceanographic experiment allowed a detailed examination of the structure and variability of a small portion of the Atlantic North Equatorial Countercurrent. The major components of the temporal variability were determined through spectral analysis of the current meter records. Oscillations of semidiurnal frequency and near-inertial frequency dominated the records. Near-inertial frequency oscillations accounted for about 20 percent of the total variance and semidiurnal frequency oscillations accounted for another 14 percent of the total variance. The 24 day mean flow was 0.43 m/sec toward 70 degrees true at 7.6 m, with a maximum speed of 0.80 m/sec recorded on 8 September. The vertical structure of the mean flow was such that the velocity vector decreased in magnitude with increasing depth and rotated toward the north (i.e., anticlockwise with increasing depth). The amplitude of the inertial oscillations showed considerable depth dependence. The semidiurnal tidal oscillations were found to be predominantly baroclinic and a simple, two layer internal wave model yielded close agreement between the predicted and observed phase speed and wavelength. Dissert. Abstr.

N81-11620# Sandia Corp., Albuquerque, N. Mex. Fluid and Thermal Sciences Dept.
THERMOPHYSICAL PROPERTIES OF DEEP OCEAN SEDIMENTS
G. R. Hadley, D. E. McVey, and R. Morin (Rhode Island Univ., Kingston) 1980 6 p refs Presented at Marine Technol. Conf., Washington, D.C.
(Contract DE-AC04-76DP-00789; AT(29-1)-789)
(SAND-80-1533C; CONF-801020-1) Avail: NTIS HC A02/MF A01

Measurements of the thermal conductivity and diffusivity of reconsolidated illite and smectite ocean sediments at a pore pressure of 600 bars and temperatures ranging from 25 to

420 C are reported. The conductivity and diffusivity were found to be in the range of 0.8 to 1.0 W/m-K and 2.2 to 2.8 x 0.0000001 m2/s, respectively. These data are consistent with a mixture model which predicts sediment thermal properties as a function of constituent properties and porosity. Comparison of pre and post test physical properties indicated a decrease in pore water content and an order of magnitude increase in shear strength and permeability. DOE

N81-11621# Washington Univ., Seattle. Applied Physics Lab.

ACOUSTICS AND PROPERTIES OF THE OCEAN:

M. Schulkin Sep. 1980 51 p refs Presented at the Plenary Session of Oceans 1980, Seattle, Sep. 1980

(Contract N00014-77-C-0309)

(AD-A090054; APL-UW-TN-9-80) Avail: NTIS HC A04/MF A01 CSCL 08/10

Acoustical techniques are being used to determine properties of the ocean for scientific and engineering applications. This paper reports on existing concepts and problems in the application of acoustics to oceanic chemistry, geology, biology and dynamics which can be treated in the next decade. By using different regions of the acoustic spectrum and different acoustic path configurations, information can be obtained concerning such topics as climate and weather, fisheries, ocean pollution, bathymetry and currents. These subjects were discussed in the recent NOAA Workshop on Ocean Acoustic Remote Sensing (Seattle, January 1980). GRA

N81-11622# Naval Postgraduate School, Monterey, Calif.

RELATIONSHIPS BETWEEN SEA SURFACE TEMPERATURE AND NUTRIENTS IN SATELLITE DETECTED OCEAN FRONTS M.S. Thesis

John Woeppel Conrad Mar. 1980 115 p refs

(AD-A089930) Avail: NTIS HC A06/MF A01 CSCL 17/5

Satellite IR images of the California coast off Point Sur reveal recurrent surface features which appear to be 'thermal discontinuities' associated with aperiodic upwelling events. Some of these have associated 'chemical fronts' and increased biological activity. Satellite IR imagery was used to locate 'discontinuities' and with in situ monitoring the development of three features were studied. Interrelationships between sea surface temperature nutrients and microplanktonic biomass were investigated. Nutrient ratios, satellite imagery, wind stress data and correlations between nutrients and temperature were used to develop an estimate of 'age' within a simplified upwelling 'life cycle' model. The features range in scale from tens to hundreds of kilometers. Two upwelling features exhibited very strong correlations between nutrient and temperature but a third feature had considerable nutrient variability. This suggests a considerable impact from the dynamic and biological processes. The technique of coupling satellite imagery and in situ monitoring was found to be a feasible method to provide real time inferences of the nutrient structure associated with an upwelled thermal feature. GRA

N81-11623# North Carolina State Univ., Raleigh. Dept. of Marine Science and Engineering.

NEARSHORE WAVE CHARACTERISTICS GENERATED BY VARIABLE WINDS Final Report, 1 Feb. 1979 - 31 Jan. 1980

M. Aziz Tayfun Jan. 1980 45 p refs

(Contract N00014-79-C-0287; NR Proj. 388-150)

(AD-A089716; NCSU-79-7) Avail: NTIS HC A03/MF A01 CSCL 08/3

The prediction of wave characteristics generated by variable winds under fetch-and duration-limited conditions is considered by using a parametric approach and a simplified form of the radiative transport equation. The wind-generated sea surface is characterized in terms of an equilibrium range spectrum with a well-defined low wave number cut-off. By relating the local wind velocity to the rate of increase in wave energy and incorporating the refractive and frictional effects of transitional water depths into the formulation, governing equations are derived to predict the development of a wind-wave field in terms of integral properties of the spectrum such as mean period, direction, and significant wave height. Under deep water conditions, governing equations admit simple closed form solutions which are shown to compare very favorably with observational data as well as various wind-wave prediction formulae currently available. Consequently, they are numerically solved first for the case of wind-waves in uniform water depth and then for a circular basin with variable bathymetry as an illustrative general case. GRA

N81-11624# Colorado State Univ., Fort Collins.

CROSS-SPECTRAL STUDY OF THE SPATIAL RELATIONSHIPS IN THE NORTH PACIFIC SEA-SURFACE TEMPERATURE ANOMALY FIELD

John W. Middleton and Elmar R. Reiter Mar. 1980 120 p refs

(Contract DE-AC02-76EV-01340; Grant NSF ATM-78-17835) (COO-1340-68-DRAFT; Rept-23) Avail: NTIS HC A06/MF A01

Cross spectral analysis is used to examine the dependence of the temporal covariation of sea surface temperature anomalies at pairs of spatially separated points in the North Pacific on (1) the time scale of the variations, (2) the relative displacement of the points and (3) their location within the North Pacific basin. Spatial scales considered here range from 1000 kilometers up to the width of the basin. The study focuses on cross spectral estimates for the interannual frequency band, 0.125 to 0.75 per yr although estimates for three other bands spanning higher frequencies are also examined. DOE

N81-11625# State Univ. of New York, Stony Brook. Marine Sciences Research Center.

LAGRANGIAN AND EULERIAN DIFFUSION STUDY IN THE COASTAL SURFACE LAYERS Progress Report, 1 Jul. 1979 - 30 Jun. 1980

H. H. Carter, A. Okubo, R. E. Wilson, B. Sanderson, and D. W. Pritchard Jul. 1980 52 p refs

(Contract DE-AS02-79EV-10250)

(DOE/EV-10250/T1) Avail: NTIS HC A04/MF A01

A fundamental problem in turbulence theory, the relation between Lagrangian and Eulerian statistics was addressed, by carrying out, analyzing, and interpreting a set of field experiments in the coastal waters off the south shore of Long Island. Two experiments, one in summer and one in winter, consisting of simultaneous measurements of dye diffusion, drogue dispersion, and Eulerian current velocities in a typical coastal locale were planned. In order to ensure a match between the Lagrangian (drogues, dye) scales of motion and the Eulerian (current meters) scales, however, a preliminary experiment, consisting of a 6 mooring current meter array and a short drogue experiment, was conducted. Results of this preliminary experiment and their implications to the experimental program are discussed. The principal results were an improved design of our current meter arrays, and a wider variety of drogue experiments, i.e., multilevel, multi-scale, and continuous source simulation. DOE

N81-11626# National Oceanic and Atmospheric Administration, Boulder, Colo. Marine Ecosystems Analysis Program Office.

ENVIRONMENTAL INVESTIGATIONS DURING MANGANESE NODULE MINING TESTS IN THE NORTH EQUATORIAL PACIFIC IN NOVEMBER 1978

E. Ozturgut, J. W. Lavelle, O. Steffin, and S. A. Swift May 1980 58 p refs

(PB80-202955; NOAA-80061002; NOAA-TM-ERL-MESA-48) Avail: NTIS HC A04/MF A01 CSCL 13B

The results of environmental studies conducted during the monitoring of a pilot scale manganese nodule mining operation are presented. Observations of the chemical and physical structure of the upper 300 m of the water column, nephelometry and particulate sampling, light profiles, primary production experiments, and macrozooplankton studies are included. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N81-11627*# University of Central Florida, Orlando. Dept. of Biological Sciences.

A CONTINUATION OF BASE-LINE STUDIES FOR ENVIRONMENTALLY MONITORING SPACE TRANSPORTATION

SYSTEMS AT JOHN F. KENNEDY SPACE CENTER. VOLUME 2: CHEMICAL STUDIES OF RAINFALL AND SOIL ANALYSIS Final Report, Jul. 1977 - Mar. 1979
B. C. Madsen Aug. 1980 638 p refs
(Contract NAS10-8986)
(NASA-CR-163122; KSC-TR-51-2-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 13B

The results of a study which was designed to monitor, characterize, and evaluate the chemical composition of precipitation (rain) which fell at the Kennedy Space Center, Florida (KSC) during the period July 1977 to March 1979 are reported. Results which were obtained from a soil sampling and associated chemical analysis are discussed. The purpose of these studies was to determine the environmental perturbations which might be caused by NASA space activities. Author

N81-11628# Chicago Univ., Ill.
MOLECULAR BIOLOGY OF ENVIRONMENTAL AROMATIC HYDROCARBONS Progress Report, 1 Jan. - 31 Dec. 1980
Samuel B. Weiss Jul. 1980 12 p
(Contract DE-AC02-80EV-10328)
(DOE/EV-10328/1) Avail: NTIS HC A02/MF A01

Three different aspects of hydrocarbon action are investigated: the biochemical effect of benzo(a)pyrene-diol-epoxide on the replication of Simian virus 40; the reaction of benzo(a)pyrene-7,8-diol with viral DNA; and the effect of PAH derivatives on RNA transcription. DOE

N81-11629# Kansas State Univ., Manhattan. Dept. of Biochemistry.
MOLECULAR BASIS OF THE MUTAGENIC AND LETHAL EFFECTS OF ULTRAVIOLET IRRADIATION Progress Report
L. Grossman 1980 6 p
(Contract DE-AC02-76EV-02814)
(DOE/EV-02814/1) Avail: NTIS HC A02/MF A01

Research progress is reported in the purification of human placental DNA repair enzymes and the determination of their properties. DOE

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N81-11630 Stanford Univ., Calif.
SIGNAL-PROCESSING TECHNIQUES AND TRANSDUCER-MULTIPLEXING CIRCUITRY FOR IMPLANTABLE DIMENSION AND BLOOD-FLOW MEASUREMENT SYSTEMS Ph.D. Thesis
Eric Joseph David Wildi 1980 224 p
Avail: Univ. Microfilms Order No. 8024757

The advent of integrated circuits made possible the development of sophisticated totally implantable instruments for use in long term animal research. A spectral analysis of the sent and received signals in a pulsed Doppler ultrasonic blood flowmeter demonstrates the limited use of the standard Doppler equation in determining system performance in the presence of short ultrasonic bursts and the need for audio filters having an f/sin (f) amplitude characteristic in their passband. An investigation of the Doppler based blood/muscle interface detection technique identifies the need for automatic gain control in the feedback circuitry to obtain stable operation, and a small signal model describes the tracking dynamics in terms of known system parameters. Multiplexing at the transducer level is the most attractive method for extending the capability of current implantable units to multiple dimension and/or flow measurements. Several architectures for new multiparameter systems are proposed, and in vitro and in vivo experiments involving hard wired multiple pulsed and CW Doppler flowmeters validate the transducer multiplexing approach. Dissert. Abstr.

N81-11631*# Fairchild Republic Div., Farmingdale, N. Y.
SPACECRAFT SURGICAL SCRUB SYSTEM Final Report
M. Abbate 3 Oct. 1980 15 p refs
(Contract NAS9-16024)
(NASA-CR-160882; MS187R5003) Avail: NTIS HC A02/MF A01 CSCL 06B

Ease of handling and control in zero gravity and minimizing the quantity of water required were prime considerations. The program tasks include the selection of biocidal agent from among the variety used for surgical scrub, formulation of a dispensing system, test, and delivery of flight dispensers. The choice of an iodophore was based on effectiveness on single applications, general familiarity among surgeons, and previous qualification for space use. The delivery system was a choice between the squeeze foamer system and impregnated polyurethane foam pads. The impregnated foam pad was recommended because it is a simpler system since the squeeze foamer requires some applicator to effectively clean the skin surfaces, whereas the form pad is the applicator and agent combined. Testing demonstrated that both systems are effective for use as surgical scrubs. S.F.

N81-11632# Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, Md.
THE PRONE PROTECTED POSTURE
David T. Kilminster and Gary L. Holloway Aug. 1980 122 p refs
(DA Proj. 1R7-65706-M-541)
(AD-A089818; AMSAA-TR-284) Avail: NTIS HC A06/MF A01 CSCL 15/3

The prone protected posture is defined as a prone man taking cover in, under, or beside some piece of equipment, a man-made feature, or a natural feature. The vulnerability of a prone protected man is less than that of a prone man but greater than that of a man crouching in a foxhole. The prone protected man is described by nine different functions representative of mechanized infantry, artillery, supply, and transportation personnel. Eight of these functions are combined by a weighting scheme based on the Soviet Army organization into one function. The resultant function is used to calculate some representative lethal areas. GRA

N81-11633# Brookhaven National Lab., Upton, N. Y. Medical Research Center.
EFFECT OF PHYSICAL ACTIVITY ON BODY COMPOSITION
I. Zanzi, K. J. Ellis, J. Aloia, and S. H. Cohn 1980 8 p refs Presented at the 10th Steenback Symp., Madison, Wis., 8 Jun. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28008; CONF-800690-1) Avail: NTIS HC A02/MF A01

The relation between total body calcium, total body potassium and bone mineral content of the radius to the degree of physical activity in a population of normal subjects was determined. Measurement of the calcium was made by in-vivo total body neutron activation analysis. Bone mineral content of the radius and total body potassium, (an index of lean body mass) were measured by photon absorptiometry and the whole body counter, respectively. DOE

N81-11634# Argonne National Lab., Ill.
RADIOACTIVITY IN MAN: LEVELS, EFFECTS AND UNKNOWNS
J. Rundo 1980 16 p refs Presented at the Public Meeting on Federal Res. into Biol. Effects of Ionizing Radiation, Bethesda, Md., 10-11 Mar. 1980
(Contract W-31-109-eng-38)
(CONF-800392-1) Avail: NTIS HC A02/MF A01

The potential for significant human exposure to internal radiation is discussed. Sources of radiation considered include background radiation, fallout, reactor accidents, radioactive waste, and occupational exposure to various radioisotopes. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N81-11635# Montclair State Coll., Upper Montclair, N.J.
THE INFLUENCE OF FIGURAL COMPLEXITY ON THE

DETECTION, RECOGNITION, AND IDENTIFICATION OF TARGETS, IN COMPUTER GENERATED DISPLAYS Final Report

Moira K. LeMay 30 Jul. 1980 42 p refs
(Grant AF-AFOSR-0103-79; AF Proj. 2313)
(AD-A089945; AFOSR-80-0965TR) Avail: NTIS HC A03/MF A01 CSCL 05/9

Computer-generated images (CGI) or displays in simulators provide a cost-effective approach to training pilots in the use of infrared and other types of electrooptical (E/O) displays for night flying. The cost of simulating objects on a CIG display is proportional to the amount of display complexity. The present investigation attempted to assess the amount of complexity in simulation necessary for the detection, recognition, and identification of targets in a scene. GRA

N81-11990*# Alabama Univ. in Huntsville. Development Learning Program.

PAYLOAD CREW TRAINING COMPLEX (PCTC) UTILIZATION AND TRAINING PLAN Status Report

Michael R. Self *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 20 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 05I

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N81-11636# Maryland Univ., College Park. Computer Vision Lab.

USING QUADTREES TO SMOOTH IMAGES

Sanjay Ranade and Michael Shneier Apr. 1980 14 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090247; TR-894) Avail: NTIS HC A02/MF A01 CSCL 05/8

Three methods for smoothing images are presented. All three use variable numbers of picture points over which the smoothing functions are defined. The first method examines the histogram of a neighborhood of each point. The subset of gray values most similar to that of the point is used in calculating the smoothing functions. The other two methods use quadtree approximations to smooth the image. One of these uses the sizes of the leaves in the quadtree to determine neighborhood sizes over which to apply a smoothing function, while the other refines the gross smoothing defined by the quadtree. All the methods perform fairly well, but the quadtree methods are particularly attractive because of the information about region sizes and homogeneity provided by the quadtree structure. GRA

N81-11637# Pittsburgh Univ., Pa.

OBSERVED COMPENSATION FOR PROJECTIVE DISTORTION OF GRAPHIC DISPLAYS

Richard R. Rosinski and Harry L. Chiesi 15 Jul. 1980 56 p refs
(Contract N00014-77-C-0679)
(AD-A090188) Avail: NTIS HC A04/MF A01 CSCL 05/8

Graphic displays can provide accurate representations of three dimensional space only if they are viewed from the geometric center of projection. Other viewing conditions result in distortions of virtual space. In our earlier reports we have proposed two processes by which the perceptual system discounts these distortions: an active compensation and a passive categorization. The present report describes 3 sets of studies which demonstrate the nature of these processes. In the first experiment, observers made magnitude estimate judgments of the depth of unfamiliar, 7-sided objects. Distortions were induced by moving the center of projection. Judgments corresponded almost completely with the distorted virtual space. In the second experiment, distortions were induced by moving the observer. No effect of the distortions was found in this situation indicating perfect perceptual compensation. These results replicate and extend our earlier findings. GRA

N81-11638# Massachusetts Inst. of Tech., Cambridge. Dept. of Psychology.

EFFICIENT COMPUTATIONS AND REPRESENTATIONS OF VISIBLE SURFACES Final Report, 1 Oct. 1978 - 31 Oct. 1979

Whitman Richards and Kent A. Stevens Dec. 1979 75 p refs
(Grant AF-AFOSR-0020-79; AF Proj. 2313)
(AD-A089832; AFOSR-80-0966TR) Avail: NTIS HC A04/MF A01 CSCL 05/8

This report addresses two problems, the extraction of surface shape information from the image of contours lying on a surface and the determination of transparency. Our preliminary analyses discuss the constraints and assumptions that underly the perception of surface shape and transparency. The identification and elucidation of these assumptions and constraints is important for the design of flight simulators, in order that synthetic images are not built up from conflicting ones that will mislead the observer. The first part of the report examines our perception of surface contours (e.g., the projections of linear surface markings such as seams, wrinkles, pigmentation edges, glossy reflections, and shadow edges). Generally such contours lie interior to the silhouette of an object and have been regarded as merely contributing to texture, or to making the surface appear solid, or simply adding to the complexity of the image. In fact, they constitute an important source of information about surface shape. GRA

N81-11639# Dynamics Research Corp., Wilmington, Mass. Advanced Systems Dept.

HUMAN RESOURCES, LOGISTICS, AND COST FACTORS IN WEAPON SYSTEM DEVELOPMENT PROJECT SUMMARY Final Report

Gerard F. King and William R. Askren Brooks AFB, Texas AFHRL Sep. 1980 74 p refs
(Contract F33619-77-C-0016; AF Proj. 1959)
(AD-A089708; AFHRL-TR-80-8) Avail: NTIS HC A04/MF A01 CSCL 15/5

This report provides a summary of an Air Force advanced development effort, Integration and Application of Human Resource Technologies in Weapon System Design. The project resulted in the development and demonstration of a methodology, the coordinated human resource technology (CHRT), and its complementary consolidated data base. The methodology is applicable throughout weapon system acquisition and provides for (a) the early assessment of the system design and support plan impact on human resources, logistics, and costs, and (b) the development of a mutually supportive and coordinated training program and technical manual set. Specifically, this report summarizes (a) the development of CHRT and the CDB, (b) the demonstration of the CHRT and the CDB on major systems of the Advanced Medium STOL Transport, (c) CHRT and the CDB as they presently are defined, and (d) the guidelines for future application of CHRT and the CDB. GRA

N81-11986*# Auburn Univ., Ala. Dept. of Mathematics.

A RANKING ALGORITHM FOR SPACELAB CREW AND EXPERIMENT SCHEDULING

Robert D. Grone and Frank H. Mathis *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 18 p (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 05H

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering*.

N81-11640 Stanford Univ., Calif.
ON THE DESIGN, USE, AND INTEGRATION OF DATA MODELS Ph.D. Thesis
Ramez Aziz El-Masri 1980 229 p
Avail: Univ. Microfilms Order No. 8024649

An integration methodology for logical data base design of large, integrated, multi-user data base systems is developed. In the integration approach, the individual user groups within the organization define their data and processing requirements using a formal data model. The data models define relationships among data that must be obeyed and are integrated to form a global data base mode, which supports the individual models. A three level data base management system architecture, similar to the ANSI/SPARC architecture, is assumed. Dissert. Abstr.

N81-11641 Stanford Univ., Calif.
PERFORMANCE CHARACTERISATION OF PARALLEL PROCESSOR ORGANISATIONS Ph.D. Thesis
Ruby Bei-Loh Lee 1980 225 p
Avail: Univ. Microfilms Order No. 8024696

Effective means for characterizing the expected performance potential of parallel processor organizations are developed. A unified software-hardware model is given, including the logical constraints on parallelism imposed by the program environment, the physical constraints imposed by the architectural resources, and the scheduling constraints of the operating system. From this, canonic forms of parallel computations are derived, for quantitative analysis. The concepts of equivalency, optimality, and acceptability of both serial and parallel computations are also defined. Four categories of performance criteria are identified. Mathematical hypotheses on the parallelism distribution in computations are proposed, yielding simple characterizations of performance that agree well with empirical observations. The average speed, or parallel index measure, is found to have an upper bound on the order of $P/\ln(P)$ and a lower bound on the order of $\ln(P)$, where P is the maximum degree of parallelism in any step of the computation, and $\ln(P)$ is the natural logarithm of P. Dissert. Abstr.

N81-11642 Stanford Univ., Calif.
THEORY OF COMPILER SPECIFICATION AND VERIFICATION Ph.D. Thesis
Wolfgang Heinz Polak 1980 294 p
Avail: Univ. Microfilms Order No. 8024733

The formal specification, design, implementation, and verification of a compiler for a PASCAL-like language is described. The compiler is a real, practical compiler translating a string of characters into machine code efficiently; all components of the compilation process such as scanning, parsing, type checking, and code generation are considered. The implemented language contains most control structures of PASCAL, recursive procedures and functions, and jumps. It provides user defined data types including arrays, records, and pointers. A simple facility for input-output is provided. Several existing methods for the formal definition of programming languages are reviewed and suitable technique is adapted and applied. Several technical and methodological problems of mechanically verifying large software systems are considered. Verification is a most useful tool during top down program development as it allows verification of design decisions on any level of abstraction. It is argued that verification should be an integral part of the development process. It is shown how an efficient program can be developed systematically from the specification of the compiler with the aid of an automated verifier. Dissert. Abstr.

N81-11643 Stanford Univ., Calif.
A LANGUAGE-ORIENTED APPROACH TO COMPUTER ARCHITECTURE Ph.D. Thesis
Clark Roger Wilcox 1980 380 p
Avail: Univ. Microfilms Order No. 8024756

A language-oriented approach to computer architecture is discussed. The approach starts with a high-level language, from which an ideal program representation and execution environment is derived, which in turn determines an ideal processor architecture. This is in contrast to the conventional approach wherein a single fixed instruction set supports all languages. In order to examine and evaluate the issues raised by the language-oriented approach, a methodology is presented for deriving successive levels in a design hierarchy consisting of the following components: an abstract syntax and abstract semantics for the language; derivation and interpretation of a token stream and a bit-oriented code stream; language processor architecture; and program monitoring facilities. The methodology is applied to a particular machine-independent high level language in order to obtain detailed data concerning static program size and dynamic execution characteristics. A language-specific representation, postfix code, is designed according to this methodology. A computer architecture is designed for interpretive execution of bit-oriented code streams. Dissert. Abstr.

N81-11644*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AEROSPACE APPLICATIONS OF MICROPROCESSORS
1980 269 p refs Workshop held in Greenbelt, Md., 3-4 Nov. 1980; sponsored by NASA. Goddard Space Flight Center and AIAA
(NASA-CP-2158) Avail: NTIS HC A12/MF A01 CSCL 09B

An assessment of the state of microprocessor applications is presented. Current and future requirements and associated technological advances which allow effective exploitation in aerospace applications are discussed. For individual titles, see N81-11645 through N81-11673.

N81-11645*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
AN IMAGING INFRARED (IIR) SEEKER USING A MICROPROGRAMMED PROCESSOR
Kerry V. Richmond *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 1-6 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

A recently developed Imaging Infrared Seeker uses a microprogrammed processor to perform gimbal servo control and system interface while performing the seeker functions of automatic target detection, acquisition, and tracking. The automatic detection mode requires up to 80% of the available capability of a high performance microprogrammed processor. Although system complexity was increased significantly, this approach can be cost effective when the basic computation capacity is already available. L.F.M.

N81-11646*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EIGHT MICROPROCESSOR-BASED INSTRUMENT DATA SYSTEMS IN THE GALILEO ORBITER SPACECRAFT
Robert C. Barry *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 7-16 (For primary document see N81-11644 02-60)
(Contract NAS7-100)
Avail: NTIS HC A12/MF A01 CSCL 09B

Instrument data systems consist of a microprocessor, 3K bytes of Read Only Memory and 3K bytes of Random Access Memory. It interfaces with the spacecraft data bus through an isolated user interface with a direct memory access bus

adaptor, and/or parallel data from instrument devices such as registers, buffers, analog to digital converters, multiplexers, and solid state sensors. These data systems support the spacecraft hardware and software communication protocol, decode and process instrument commands, generate continuous instrument operating modes, control the instrument mechanisms, acquire, process, format, and output instrument science data. L.F.M.

N81-11647*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A COMMAND AND DATA SUBSYSTEM FOR DEEP SPACE EXPLORATION BASED ON THE RCA 1802 MICROPROCESSOR IN A DISTRIBUTED CONFIGURATION

Jack S. Thomas *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 17-20 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

The Command and Data Subsystem (CDS) is an RCA 1802 microprocessor based subsystem that acts as the central nervous system for the Galileo Orbiter Spacecraft. All communication between the ground and spacecraft flows through the CDS. The CDS also distributes commands in real time, algorithmetrically expanded from a data base loaded from the ground and in response to spacecraft alarms. The distributed microprocessor system is configured as a redundant set of hardware with three microprocessors on each half. The microprocessors are surrounded by a group of special purpose hardware components which greatly enhance the ability of the software to perform its task. It is shown how the software architecture makes a distributed system of six microprocessors appear to each user as a single virtual machine, and collectively as a set of cooperating virtual machines that prevent the simultaneous presence of the several users from interfering destructively with each other. Author

N81-11648*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SYNERGISTIC INSTRUMENT DESIGN

Dale E. Winter *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 21-27 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

An instrument design approach for use in the Galileo Project is presented. The approach emphasizes that all instrument systems are compatible and allow the most efficient use of available hardware and software. L.F.M.

N81-11649*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

APPLICATION OF MICROPROCESSORS TO INTERPLANETARY SPACECRAFT DATA SYSTEMS

Samuel G. Deese *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 29-35 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

The Galileo Command and Data Subsystems (CDS) is described. The CDS takes advantage of microprocessor technology which serves as the core of the distributed data system. The microprocessors are interconnected by a high speed data bus. T.M.

N81-11650*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE ROLE OF THE MICROPROCESSOR IN ONBOARD IMAGE PROCESSING FOR THE INFORMATION ADAPTIVE SYSTEM

W. Lane Kelly, IV and Barry D. Meredith *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 37-45 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

The preliminary design of the Information Adaptive System is presented. The role of the microprocessor in the implementation of the individual processing elements is discussed. Particular emphasis is placed on multispectral image data processing. T.M.

N81-11651*# TRW Defense and Space Systems Group, Redondo Beach, Calif.

APPLICATION OF A MICROPROCESSOR TO A SPACECRAFT ATTITUDE CONTROL

D. H. Brady and F. W. Hermann *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 47-55 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

The attitude control system (ACS) microprocessor development work spanned three main design areas: hardware and instruction set, ACS firmware, and hardware firmware verification testing. The processor hardware utilizes two parallel 4 bit microprocessors. The firmware includes data processing for five sensors, four attitude control laws, and telemetry and commands. T.M.

N81-11652*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A PLASMA WAVE FOURIER TRANSFORM PROCESSOR EMPLOYING 1802 MICROCOMPUTERS FOR SPACECRAFT INSTRUMENTATION

Donald C. Lokerson and James N. Caldwell *In its* Aerospace Appl. of Microprocessors 1980 p 57-64 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

The processing of plasma wave signals in spinning spacecraft in the range from D.C. to 500 Hz are described. Three antenna inputs were filtered to prevent aliasing above 500 Hz. A 92 db range of data was multiplexed to an analog to digital converter, and then to three RCA 1802 microcomputers. T.M.

N81-11653*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PROTOTYPE DEVELOPMENT OF A MICROPROCESSOR BASED ONBOARD ORBIT DETERMINATION SYSTEM

Keiji K. Tasaki and Rose S. Pajerski *In its* Aerospace Appl. of Microprocessors 1980 p 65-68 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

An automated orbit determination system (AODS) is described. The AODS is used in conjunction with an orbital simulator. The system, based on microprocessors, enables onboard orbital position estimation. T.M.

N81-11654*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE REMOTE COMPUTER CONTROL (RCC) SYSTEM

William Holmes *In its* Aerospace Appl. of Microprocessors 1980 p 69-72 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

A system to remotely control job flow on a host computer from any touchtone telephone is briefly described. Using this system a computer programmer can submit jobs to a host computer from any touchtone telephone. In addition the system can be instructed by the user to call back when a job is finished. Because of this system every touchtone telephone becomes a conversant computer peripheral. This system known as the Remote Computer Control (RCC) system utilizes touchtone input, touchtone output, voice input, and voice output. The RCC system is microprocessor based and is currently using the INTEL 80/30 microcomputer. Using the RCC system a user can submit, cancel, and check the status of jobs on a host computer. The RCC system peripherals consist of a CRT for operator control, a printer for logging all activity, mass storage for the storage of user parameters, and a PROM card for program storage. M.G.

N81-11655*# Singer-Kearfott, Little Falls, N. J.

A MICROPROCESSOR APPLICATION TO A STRAPDOWN LASER GYRO NAVIGATOR

C. Giardina and E. Luxford *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 73-78 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

The replacement of analog circuit control loops for laser gyros (path length control, cross axis temperature compensation loops, dither servo and current regulators) with digital filters residing in microcomputers is addressed. In addition to the control loops, a discussion is given on applying the microprocessor hardware to compensation for coning and skulling motion where simple algorithms are processed at high speeds to compensate component output data (digital pulses) for linear and angular vibration motions. Highlights are given on the methodology and

system approaches used in replacing differential equations describing the analog system in terms of the mechanized difference equations of the microprocessor. Standard one for one frequency domain techniques are employed in replacing analog transfer functions by their transform counterparts. Direct digital design techniques are also discussed along with their associated benefits. Time and memory loading analyses are also summarized, as well as signal and microprocessor architecture. Trade offs in algorithm, mechanization, time/memory loading, accuracy, and microprocessor architecture are also given. M.G.

N81-11656*# Intermetrics, Inc., Cambridge, Mass.
THE SPACELAB EXPERIMENT INTERFACE DEVICE (SEID)
Ron Kallus and Saul Stantent *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 79-92 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

The Spacelab experiment interface device (SEID) is described which simulates the electrical, and logical connections of the Spacelab remote acquisition unit (RAU), the interface functions of the Spacelab experiment computer software, and the electrical aspects of the high rate multiplexer. Simulated RAU interfaces include PCM serial channels (up to four), user time clock (UTC), flexible inputs (up to 128) and discrete outputs (up to 64). Connectors are logically compatible with the rau. be instructed to execute sequences of input/output commands to the RAU, similar to those performed during flight. This approximation of the experiment computer software is adequate to detect interface problems and prevent these from occurring during Spacelab payload integration. The SEID hardware is a microprocessor based system, utilizing an 8085 microprocessor with 6K of PROM and 4K of static RAM. The basic unit is augmented with an LSI-11 microcomputer to provide disk storage and a more dynamic environment for generation of control data. A simulation of the general monitoring loop is provided to emulate Spacelab system timing. M.G.

N81-11657*# Goodyear Aerospace Corp., Akron, Ohio.
G-CUEING MICROCONTROLLER (A MICROPROCESSOR APPLICATION IN SIMULATORS)
Chris G. Horattas *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 93-102 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

A g cueing microcontroller is described which consists of a tandem pair of microprocessors, dedicated to the task of simulating pilot sensed cues caused by gravity effects. This task includes execution of a g cueing model which drives actuators that alter the configuration of the pilot's seat. The g cueing microcontroller receives acceleration commands from the aerodynamics model in the main computer and creates the stimuli that produce physical acceleration effects of the aircraft seat on the pilots anatomy. One of the two microprocessors is a fixed instruction processor that performs all control and interface functions. The other, a specially designed bipolar bit slice microprocessor, is a microprogrammable processor dedicated to all arithmetic operations. The two processors communicate with each other by a shared memory. The g cueing microcontroller contains its own dedicated I/O conversion modules for interface with the seat actuators and controls, and a DMA controller for interfacing with the simulation computer. Any application which can be microcoded within the available memory, the available real time and the available I/O channels, could be implemented in the same controller. M.G.

N81-11658*# Goodyear Aerospace Corp., Akron, Ohio.
MICROPROCESSOR SOFTWARE APPLICATIONS FOR FLIGHT TRAINING SIMULATORS
Wayne P. Leavy *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 103-111 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

The g cueing system software design and implementation in the dual microprocessor system of the F-15 operational flight training simulator g cueing system is presented. The software is structured in the two microcomputers such that one serves as a controller performing all logical functions and interface with the host computer system while the other serves as an arithmetic unit performing all mathematical functions. M.G.

N81-11659*# Naval Air Development Center, Warminster, Pa.
AN EXPERIMENTAL DISTRIBUTED MICROPROCESSOR IMPLEMENTATION WITH A SHARED MEMORY COMMUNICATIONS AND CONTROL MEDIUM
Richard S. Mejzak *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 113-123 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

The distributed processing concept is defined in terms of control primitives, variables, and structures and their use in performing a decomposed discrete Fourier transform (DET) application function. The design assumes interprocessor communications to be anonymous. In this scheme, all processors can access an entire common database by employing control primitives. Access to selected areas within the common database is random, enforced by a hardware lock, and determined by task and subtask pointers. This enables the number of processors to be varied in the configuration without any modifications to the control structure. Decompositional elements of the DFT application function in terms of tasks and subtasks are also described. The experimental hardware configuration consists of IMSAI 8080 chassis which are independent, 8 bit microcomputer units. These chassis are linked together to form a multiple processing system by means of a shared memory facility. This facility consists of hardware which provides a bus structure to enable up to six microcomputers to be interconnected. It provides polling and arbitration logic so that only one processor has access to shared memory at any one time. M.G.

N81-11660*# Harris Corp., Melbourne, Fla.
DISTRIBUTED MICROPROCESSORS IN A TACTICAL UNIVERSAL MODEM
D. M. Gray, J. B. Malnar, and H. Vickers *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 125-132 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

The distributed microprocessor system associated with a wideband signal conversion unit (WBSCU) is described. Multiple embedded 8086 and 2901 microprocessors, supported by dedicated hardware modules, perform the required real time operations for both transmit and receive functions. Commands from a host computer determine the configuration of the WBSCU via the IEEE 488 bus. Each of the four WBSCU channels is assigned to process a specified IF waveform; each channel configures its own resources and, in some cases, borrows resources from other channels. The processed waveform data is communicated from individual channels to redundant global memories. Data flow between the user community and global memories occurs via redundant 1553 buses through intelligent Bus Interface Units. Each WBSCU channel contains one 2901 bit slice machine and one 8086 microprocessor. The 2901 provides high speed processing capability for the most time critical operations. The 8086 is used for lower speed processing tasks where its high level language capability can be better exploited. Each 8086 has a global bus for wideband interprocessor communication, and a local bus for 8086/2901, master/slave communication. Software architecture consists of a control and communications structure governing mode dependent signal processing tasks. M.G.

N81-11661*# Ford Aerospace and Communications Corp., Houston, Tex.
MICROCOMPUTER SOFTWARE DEVELOPMENT FACILITIES
J. S. Gorman and C. Mathiasen *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 133-138 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

A more efficient and cost effective method for developing microcomputer software is to utilize a host computer with high-speed peripheral support. Application programs such as cross assemblers, loaders, and simulators are implemented in the host computer for each of the microcomputers for which software development is a requirement. The host computer is configured to operate in a time share mode for multiusers. The remote terminals, printers, and down loading capabilities provided are based on user requirements. With this configuration a user, either local or remote, can use the host computer for microcomputer

software development. Once the software is developed (through the code and modular debug stage) it can be downloaded to the development system or emulator in a test area where hardware/software integration functions can proceed. The microcomputer software program sources reside in the host computer and can be edited, assembled, loaded, and then downloaded as required until the software development project has been completed. A.R.H.

N81-11662*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MICROPROCESSOR USER SUPPORT AT LANGLEY RESEARCH CENTER

Jerry H. Tucker *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 139-142 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

The use of microprocessors pose significant problems including: (1) a long learning process for proficient use of microprocessors; (2) the requirement for extensive support in both hardware and software; and (3) the need for coordination and sharing of the creative effort to avoid unnecessary duplication. To address these problems, Langley Research Center has established a microprocessor users committee to provide an advisory interface for management and users, and is training microprocessor users. A newsletter is published to disseminate information among microprocessor users. Both cross software on the central computer complex and microprocessor development systems are used to support the design of microprocessor based systems. Each of these activities is reviewed with special emphasis given to the microprocessor support available from the central computer complex. The effectiveness of the approach being taken at Langley is assessed and specific hardware and software development efforts that are targeted toward enhancing the existing microprocessing support are discussed. A.R.H.

N81-11663*# General Dynamics/Pomona, Calif. Western Data Systems Center.

DEBUGGING EMBEDDED COMPUTER PROGRAMS

Gilbert H. Kemp *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 143-149 ref (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

Every embedded computer program must complete its debugging cycle using some system that will allow real time debugging. Many of the common items addressed during debugging are listed. Seven approaches to debugging are analyzed to evaluate how well they treat those items. Cost evaluations are also included in the comparison. The results indicate that the best collection of capabilities to cover the common items present in the debugging task occurs in the approach where a minicomputer handles the environment simulation with an emulation of some kind representing the embedded computer. This approach can be taken at a reasonable cost. The case study chosen is an embedded computer in a tactical missile. Several choices of computer for the environment simulation are discussed as well as different approaches to the embedded emulator. A.R.H.

N81-11664*# Ford Aerospace and Communications Corp., Houston, Tex.

REAL-TIME OPERATING SYSTEM FOR SELECTED INTEL PROCESSORS

W. R. Pool *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 151-156 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

The rationale for system development is given along with reasons for not using vendor supplied operating systems. Although many system design and performance goals were dictated by problems with vendor supplied systems, other goals surfaced as a result of a design for a custom system able to span multiple projects. System development and management problems and areas that required redesign or major code changes for system implementation are examined as well as the relative successes of the initial projects. A generic description of the actual project is provided and the ongoing support requirements and future plans are discussed. A.R.H.

N81-11665*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A FOURIER TRANSFORM WITH SPEED IMPROVEMENTS FOR MICROPROCESSOR APPLICATIONS

Donald C. Lokerson and Robert Rochelle *In its* Aerospace Appl. of Microprocessor 1980 p 157-159 Prepared in cooperation with Tennessee Univ., Knoxville (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

A fast Fourier transform algorithm for the RCA 1802 microprocessor was developed for spacecraft instrument applications. The computations were tailored for the restrictions an eight bit machine imposes. The algorithm incorporates some aspects of Walsh function sequency to improve operational speed. This method uses a register to add a value proportional to the period of the band being processed before each computation is to be considered. If the result overflows into the DF register, the data sample is used in computation; otherwise computation is skipped. This operation is repeated for each of the 64 data samples. This technique is used for both sine and cosine portions of the computation. The processing uses eight bit data, but because of the many computations that can increase the size of the coefficient, floating point form is used. A method to reduce the alias problem in the lower bands is also described. E.D.K.

N81-11666*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FAME, A MICROPROCESSOR BASED FRONT-END ANALYSIS AND MODELING ENVIRONMENT

Jacob D. Rosenbaum and Edward B. Kutin *In its* Aerospace Appl. of Microprocessors 1980 p 161-166 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

Higher order software (HOS) is a methodology for the specification and verification of large scale, complex, real time systems. The HOS methodology was implemented as FAME (front end analysis and modeling environment), a microprocessor based system for interactively developing, analyzing, and displaying system models in a low cost user-friendly environment. The nature of the model is such that when completed it can be the basis for projection to a variety of forms such as structured design diagrams, Petri-nets, data flow diagrams, and PSL/PSA source code. The user's interface with the analyzer is easily recognized by any current user of a structured modeling approach; therefore extensive training is unnecessary. Furthermore, when all the system capabilities are used one can check on proper usage of data types, functions, and control structures thereby adding a new dimension to the design process that will lead to better and more easily verified software designs. Dissert. Abstr.

N81-11667*# Martin Marietta Corp., Denver, Colo.

APPLICATION OF SOFTWARE TECHNOLOGY TO A FUTURE SPACECRAFT COMPUTER DESIGN

Robert J. LaBaugh *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 167-178 (For primary document see N81-11644 02-60)

Avail: NTIS HC A12/MF A01 CSCL 09B

A study was conducted to determine how major improvements in spacecraft computer systems can be obtained from recent advances in hardware and software technology. Investigations into integrated circuit technology indicated that the CMOS/SOS chip set being developed for the Air Force Avionics Laboratory at Wright Patterson had the best potential for improving the performance of spaceborne computer systems. An integral part of the chip set is the bit slice arithmetic and logic unit. The flexibility allowed by microprogramming, combined with the software investigations, led to the specification of a baseline architecture and instruction set. E.D.K.

N81-11668*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A TRANSLATOR WRITING SYSTEM FOR MICROCOMPUTER HIGH-LEVEL LANGUAGES AND ASSEMBLERS

W. Robert Collins, John C. Knight, and Robert E. Noonan *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 179-186 Prepared in cooperation with Computer Sciences Corp., Hampton, Va., and College of William and Mary, Williamsburg, Va. (For primary document see

N81-11644 02-60)
(Contracts NAS1-14900; NAS1-16078; Grant NSG-1435)
Avail: NTIS HC A12/MF A01 CSCL 09B

In order to implement high level languages whenever possible, a translator writing system of advanced design was developed. It is intended for routine production use by many programmers working on different projects. As well as a fairly conventional parser generator, it includes a system for the rapid generation of table driven code generators. The parser generator was developed from a prototype version. The translator writing system includes various tools for the management of the source text of a compiler under construction. In addition, it supplies various default source code sections so that its output is always compilable and executable. The system thereby encourages iterative enhancement as a development methodology by ensuring an executable program from the earliest stages of a compiler development project. The translator writing system includes PASCAL/48 compiler, three assemblers, and two compilers for a subset of HAL/S. E.D.K.

N81-11669*# Sandia Labs., Albuquerque, N. Mex.
A HIGH PERFORMANCE MULTIPLIER PROCESSOR FOR USE WITH AEROSPACE MICROCOMPUTERS
P. E. Pierce *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 187-194 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

An MC68000 based microcomputer including a hardware multiplier processor has been designed and prototyped for a reentry vehicle navigation and control application. In this paper, the microcomputer is discussed with emphasis on the multiplier processor architecture, software control and theory of operation. R.C.T.

N81-11670*# Martin Marietta Corp., Denver, Colo.
APPLICATION OF ADVANCED ELECTRONICS TO A FUTURE SPACECRAFT COMPUTER DESIGN
Philip C. Carney *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 195-211 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

Advancements in hardware and software technology are summarized with specific emphasis on spacecraft computer capabilities. Available state of the art technology is reviewed and candidate architectures are defined. R.C.T.

N81-11671*# Litton Systems, Inc., Woodland Hills, Calif.
EVOLUTION OF A STANDARD MICROPROCESSOR-BASED SPACE COMPUTER
Manuel Fernandez *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 213-266 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

An existing in inventory computer hardware/software package (B-1 RFS/ECM) was repackaged and applied to multiple missile/space programs. Concurrent with the application efforts, low risk modifications were made to the computer from program to program to take advantage of newer, advanced technology and to meet increasingly more demanding requirements (computational and memory capabilities, longer life, and fault tolerant autonomy). It is concluded that microprocessors hold promise in a number of critical areas for future space computer applications. However, the benefits of the DoD VHSIC Program are required and the old proliferation problem must be revised. R.C.T.

N81-11672*# Honeywell Systems and Research Center, Minneapolis, Minn.
MODULAR MISSILE BORNE COMPUTERS
R. Ramseyer, R. Arnold, H. Applewhite, and R. Berg *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 229-255 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

The modular missile borne computer's architecture with emphasis on how that architecture evolved is discussed. A careful analysis is given of both the physical constraints and the processing requirements. R.C.T.

N81-11673*# Goodyear Aerospace Corp., Akron, Ohio.
MICROCOMPUTER ARRAY PROCESSOR SYSTEM
Kenneth D. Slezak *In* NASA. Goddard Space Flight Center Aerospace Appl. of Microprocessors 1980 p 259-274 (For primary document see N81-11644 02-60)
Avail: NTIS HC A12/MF A01 CSCL 09B

The microcomputer array system is discussed with specific attention given to its electronic warware applications. Several aspects of the system architecture are described as well as some of its distinctive characteristics. R.C.T.

N81-11674# Little (Arthur D.), Inc., Cambridge, Mass.
RELIABILITY PREDICTION MODELING THE NEW DEVICES Final Technical Report, Sep. 1978 - Nov. 1979
Roger G. Long Jul. 1980 115 p refs
(Contract F30602-78-C-0296; AF Proj. 2338)
(AD-A090029; ADL-C-82361) Avail: NTIS HC A06/MF A01 CSCL 09/2

This report presents reliability prediction models for high density microcircuits including magnetic bubble and charge-coupled device memories for inclusion in MIL-HDBK-217C, 'Reliability Prediction of Electronic Equipment'. The approach in this investigation was unique in that the models were developed utilizing only early device life cycle data, since there was only limited field data available. Two separate models were developed. An additive hybrid type failure rate prediction model was formulated for Magnetic Bubble Memories and for the Charge-Coupled Memory devices. It was found that the NMOS Dynamic RAM model currently in MIL-HDBK-217C, Notice 1 was applicable. Both models are presented in the standard MIL-HDBK-217C format, are relatively simple to use, and allow for refinements based on field and life test data as it becomes available. Finally, the models exhibit reasonable correlation with existing field data. GRA

N81-11675# Measurement Concept Corp., Rome, N. Y.
MINICOMPUTER HARDWARE MONITOR DESIGN Final Technical Report, Nov. 1978 - Nov. 1979
B. Moritz, H. Spaanenburg, and A. J. Labout Griffiss AFB, N.Y. RADC Jun. 1980 228 p
(Contract F30602-79-C-0006; AF Proj. 4594)
(AD-A090026; RADC-TR-80-203) Avail: NTIS HC A11/MF A01 CSCL 09/2

This report has documented the exploratory research that has been conducted for the development of an AN/GYQ-21(V) hardware monitor. A description has been provided of the concept of monitoring, the users involved with monitoring and the monitoring systems that are already in existence. The objective was to put the development of the hybrid monitor into its proper perspective. The AN/GYQ-21(V) is described in detail, as well as its interfaces to the monitor. The measurement set considered to be a baseline for performance monitoring is documented in detail as well as the locations of its requisite probe-points. The major contribution towards the hardware monitor design can be found in the break-up of measurements into three stages: the vector generator, the programmable patchboard and the monitor microprocessor. The eventual hardware specification of those devices awaits the decisions that have to be made concerning the technology involved. Specifications for the software involved have been documented. All of the technical and software/organizational techniques presented in the report are within the state of the art. As a result, a microprocessor based performance monitor possessing an extraordinary degree of applicability to all potential users is eminently achievab'e. GRA

N81-11676# Ohio State Univ., Columbus. Computer and Information Science Research Center.
PARALLEL RECORD-SORTING METHODS FOR HARDWARE REALIZATION
David K. Hsiao and M. Jaishankar Menon Jul. 1980 48 p refs
(Contract N00014-15-C-0573)
(AD-A090192; OSU-CISRC-TR-80-7) Avail: NTIS HC A03/MF A01 CSCL 09/2

In this report, we demonstrate methods for implementing a fast hardware sorter in DBC. Given the trend towards cheaper processors and block-oriented access memories, we are especially

interested in methods that utilize multiple processors with large capacity block-oriented access memories in a parallel fashion. Many parallel sorting methods are already available. Most of these methods use P processors to sort P records. Even though these methods are fast, they suffer from the fact that groups of records larger than P in number will have to be sorted in separate batches and then merged. Batching and merging defeats the intent of parallelism for high performance. Our methods, therefore, attempt to use P processors to sort more than P records without the need for batching and merging. Furthermore, our methods employ block-oriented access memories (such as magnetic bubbles and charge-coupled devices). Three sorting methods are described in this report. The first one, called the odd-even sort, uses P processors, each of which utilizes its own block-access memory to accommodate M records and has two processor-to-processor interconnections. This method sorts MP records in O(M log M - MP) time. There is no restriction on either P or M. More importantly, since each processor needs to be connected to only two others, we can increase the number of processors in the sorter without having to increase the number of connections per processor. GRA

N81-11677# Texas Instruments, Inc., Dallas. Central Research Labs.
CCD CORNER-TURNING MEMORY Final Technical Report, 22 Sep. 1977 - 30 Jun. 1979
Robert J. Kansy Jul. 1980 163 p refs
(Contract F19628-77-C-0234; AF Proj. 4600)
(AD-A089729; TI-08-79-33; RADC-TR-80-152) Avail: NTIS HC A08/MF A01 CSCL 13/8

Two analog CCD reformatting memories were designed and fabricated using an n-channel, double-level, self-aligned polysilicon gate process. These unique CCD structures employ two dimensional charge transfer cells in a square memory array (32 x 32 and 64 x 64 elements) which is accessed by means of integrated CCD demultiplexer and multiplexer structures, resulting in greater dynamic range than observed in previous line-addressed designs. Details related to the design of this complex device and the results of experimental tests are presented. A secondary objective involved the development of a process-compatible bipolar output device for high speed applications. An analysis of this bipolar output circuit is presented, and experimental results are discussed. GRA

N81-11678# Los Alamos Scientific Lab., N. Mex.
DEPARTMENT OF ENERGY RESEARCH IN UTILIZATION OF HIGH-PERFORMANCE COMPUTERS
B. L. Buzbee, W. J. Worlton, G. Michael (California Univ., Lawrence Livermore Lab.), and G. Rodrigue (California Univ., Lawrence Livermore Lab.) Aug. 1980 14 p refs
(Contract W-7405-eng-36)
(LA-8470-MS) Avail: NTIS HC A02/MF A01

A brief description of high-performance computers is presented. The use of and future needs for high-performance computers within DOE, the growing complexity of applications within DOE, and areas of high performance computer systems warranting research are discussed. DOE

N81-11679# Sandia Labs., Albuquerque, N. Mex. Aerodynamics Simulation Div.
SANDIA LABORATORIES HYBRID COMPUTER AND MOTION SIMULATOR FACILITIES
Warren H. Curry and Ralph E. French May 1980 33 p
(Contract DE-AC04-76DP-00789)
(SAND-80-0697) Avail: NTIS HC A03/MF A01

Hybrid computer and motion simulator facilities are discussed. Three axis motion simulators and additional current equipment are described. DOE

N81-11680# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
DEVELOPMENT AND APPLICATION OF DATA FLOW COMPUTERS Final Report, 17 Jan. 1978 - 30 Sep. 1979
Jack B. Dennis Jan. 1980 17 p refs
(Contract W-7405-eng-48)
(UCRL-15258) Avail: NTIS HC A02/MF A01

The contributions of MIT in collaboration with the Lawrence Livermore Laboratory (LLL) in a joint study of concepts of data flow program structure, language design, and computer architecture as applied to highly parallel computation for problems of interest to LLL are described. The major achievements are the following: design of the programming language VAL; translator/interpreter implementation of VAL; analysis of a simplified hydrodynamics code - simple; and negotiation of continuing support from the Department of Energy. These activities are reviewed. DOE

N81-11681# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
FEATURES OF THE TRANSPORT AND SESSION PROTOCOLS, DRAFT REPORT
John Burruss Mar. 1980 78 p refs Sponsored by NBS
(PB80-205214; BBN-4361; NBS-GCR-80-245;
ICST/HLNP-80-1) Avail: NTIS HC A05/MF A01 CSCL 09B

The National Bureau of Standards, Institure for Computer Sciences and Technology initiated a program to develop computer network protocol standards as Federal Information Processing Standards. Protocol features as a method of determining the kernel set of essential features of a protocol along with the clusters of value added features which will support various application categories were studied. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N81-11682 Boston Univ., Mass.
STRUCTURED SOFTWARE DEVELOPMENT Ph.D. Thesis
Harvey Michael Deitel 1980 399 p
Avail: Univ. Microfilms Order No. 8024183

The problems experienced in the development of large scale software systems are examined. The need for a single medium of expression for describing the system through the various project stages of analysis, design, implementation, testing and debugging, and retrofit is suggested. This medium of expression is called SOFTCODE. The syntax and semantics of the SOFTCODE language and its use throughout the entire software life cycle are examined. An automated system for controlling the evolving software system, AUSPICES (Automated Software Product Information Control and Evaluation System), and the value of the system is demonstrated. AUSPICES is a software system designed for an interactive time sharing environment organized around a data base, data dictionary system. The combination of AUSPICES, SOFTCODE, and the data dictionary is shown to provide a number of benefits not currently realized in software development efforts.
Dissert. Abstr.

N81-11683 Stanford Univ., Calif.
MODELLING THE ENVIRONMENT OF AN EXPLORING VEHICLE BY MEANS OF STEREO VISION Ph.D. Thesis
Donald Bernard Gennery 1980 165 p
Avail: Univ. Microfilms Order No. 8024660

Research involving vision techniques is described which would be useful in an autonomous exploring vehicle, such as a Mars rover. These techniques produce a description of the surroundings of the vehicle in terms of the position, size, and approximate shape of objects, and can match such scene descriptions with others previously produced. The techniques operate by using three dimensional data which they can produce by means of stereo vision from stereo picture pairs or which can be obtained from a laser rangefinder. The research thus divides conveniently into two portions: stereo mapping and three dimensional modelling and matching. The stereo mapping techniques are designed to be suitable for the kind of pictures that a Mars rover might obtain and to produce the kind of data that the modelling techniques need. These stereo techniques are based upon area correlation and produce a depth map of the scene. Emphasis is placed upon extraction of useful data from noisy pictures and upon the estimation of the accuracy of the data produced. The three dimensional modelling and matching techniques are designed to be tolerant of the errors that stereo mapping techniques often produce. First, a ground surface finder tries to find a set of points that form a well defined smooth surface that lies below

most of the other points. Then, by using this knowledge of the ground surface and knowledge of the camera viewpoint that produced the points in the scene, an object finder approximates the objects that are above the ground by ellipsoids.
Dissert. Abstr.

N81-11684 Stanford Univ., Calif.
DETERMINING CORRECTNESS BY TESTING Ph.D. Thesis
Martin Fraser Brooks 1980 140 p
Avail: Univ. Microfilms Order No. 8024629

A mathematical theory of program testing which describes how testing can be used to show a program's correctness is presented. A situation is investigated where the programmer has written a program P which is either correct or which differs from the correct program by one or more errors in a specified class E of errors. The theory relates: (1) the combinatorics of how errors in E could have led to P being written; (2) the type of program behavior that the programmer will observe when testing, for example the program's output or a trace; (3) the characteristics of test data which is guaranteed to reveal the presence of errors in P. The theory is developed at a general level and is then specialized to the case of recursive programs having only certain types of simple errors, where the programmer observes a trace of each test run. A method for generating test data for recursive programs is derived. The test data generation method has been implemented and examples of its operation are given. Dissert. Abstr.

N81-11685 Stanford Univ., Calif.
A LANGUAGE FOR TYPESETTING GRAPHICS Ph.D. Thesis
Christopher John VanWyk 1980 64 p
Avail: Univ. Microfilms Order No. 8024749

Constructs for a programming language in which two dimensional figures can be expressed are presented. The language is intended to work with existing text-formatting systems so that text and figures can be typeset at the same time. Another application for the language is to describe VLSI circuit layout. The building block for figure language programs, called a box, includes a system of simultaneous equations that declares the relative positions of its significant points and requests for actions to be performed at those points: for example, a user may ask for lines drawn between, circles drawn around, or boxes placed at selected points. A box is called by adding enough equations to the system in its definition that its significant points can be solved for uniquely. A box call may also include additional actions to be performed during the call. The notions of drawing a line using a pattern and texturing a polygonal area follow directly from the mechanism for defining and calling boxes. Algorithms that implement these instructions for boxes composed of straight lines and circular arcs are presented along with methods to detect insufficiency or inconsistency in the defining equation systems. Dissert. Abstr.

N81-11686 Stanford Univ., Calif.
A DOMAIN-INDEPENDENT SYSTEM THAT AIDS IN CONSTRUCTING KNOWLEDGE-BASED CONSULTATION PROGRAMS Ph.D. Thesis
William James vanMelle 1980 200 p
Avail: Univ. Microfilms Order No. 8024748

An effective domain independent system, called EMYCIN is described for constructing one class of expert computer programs: rule based consultants. Such a consultant uses knowledge specific to a problem domain to provide consultative advice to a client. Domain knowledge is represented in EMYCIN primarily as production rules, which are applied by a goal directed backward chaining control structure. Rules and consultation data may have associated measures of certainty, and incomplete data are allowed. The system includes an explanation facility that can display the line of reasoning followed by the consultation program, or answer questions from the client about the contents of knowledge base. Other built in human engineering features allow the system architect to produce, with a mimimum of effort, a consultation program that is pleasing in appearance to the client. To aid the system designer in producing a knowledge base for a domain quickly and accurately EMYCIN provides a terse, stylized, but easily understood language for writing rules; performs extensive checks to catch common user errors, such as misspellings; and handles all necessary bookkeeping chores. To improve efficiency in a running consultation program, EMYCIN provides a rule compiler that transforms the system's production rules into a decision tree, eliminating the redundant computation inherent in a rule interpreter. It then compiles the resulting tree into machine code. The program can thereby use an efficient deductive mechanism for running the actual consultation, while the flexible rule format remains available for acquisition, explanation, and debugging. Several consultation programs have been written using EMYCIN, including consultants for medical problems and a consultant for a structural engineering problem. Dissert. Abstr.

N81-11687 Stanford Univ., Calif.
OBSTACLE AVOIDANCE AND NAVIGATION IN THE REAL WORLD BY A SEEING ROBOT ROVER Ph.D. Thesis
Hans Peter Moravec 1980 177 p
Avail: Univ. Microfilms Order No. 8024717

The Stanford AI lab cart is a card table sized mobile robot controlled remotely through a radio link and equipped with a TV camera and transmitter. A computer was programmed to drive the cart through cluttered indoor and outdoor spaces, gaining its knowledge about the world entirely from images broadcast by the onboard TV system. The cart determines the three dimensional location of objects around it, and its own motion among them, by noting their apparent relative shifts in successive images obtained from the moving TV camera. It maintains a model of the location of the ground, and registers objects it has seen as potential obstacles if they are sufficiently above the surface, but not too high. It plans a path to a user specified destination which avoids these obstructions. The cart moves about one meter every ten to fifteen minutes, in lurches. After rolling a meter, it stops, takes some pictures and computes for a long time. Then it plans a new path, executes a little of it, and pauses again. The program has successfully driven the cart through several 20 meter indoor courses (each taking about five hours) complex enough to necessitate three or four avoiding swerves.
Dissert. Abstr.

N81-11688*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN AUTOMATED PROCEDURE FOR DEVELOPING HYBRID COMPUTER SIMULATIONS OF TURBOFAN ENGINES
John R. Szuch and Susan M. Krosel 1980 19 p refs Proposed for presentation at the 14th Ann. Simulation Symp., Tampa, Fla., 18-20 Mar. 1981
(NASA-TM-81605; E-598) Avail: NTIS HC A02/MF A01 CSCL 09B

A systematic, computer-aided, self-documenting methodology for developing hybrid computer simulations of turbofan engines is presented. The methodology makes use of a host program that can run on a large digital computer and a machine-dependent target (hybrid) program. The host program performs all of the calculations and date manipulations needed to transform user-supplied engine design information to a form suitable for the hybrid computer. The host program also trims the self contained engine model to match specified design point information. A test case is described and comparisons between hybrid simulation and specified engine performance data are presented. S.F.

N81-11689*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
PURE PIXEL CLASSIFICATION SOFTWARE
O. A. Wehmanen Jul. 1980 53 p refs
(Contract NAS9-15800)
(NASA-CR-160872; JSC-16783; LEMSCO-15309) Avail: NTIS HC A04/MF A01 CSCL 09B

Programs are described which permit classification runs with the LARSYS software to be made on images which have the ground truth field boundaries removed. Author

N81-11690*# Georgia Univ., Athens.
COSMIC: A CATALOG OF SELECTED COMPUTER PROGRAMS
Washington NASA [1980] 150 p Sponsored by NASA
(NASA-CR-163728) Avail: NTIS HC A07/MF A01 CSCL 09B

Information is presented on various computer programs

developed in the space program which are now available to the public. Many programs from the Department of Defense and selected software from other government agencies are also offered. Over 1500 programs in almost every technical or managerial discipline are available. R.C.T.

N81-11691# Harris Corp., Syosset, N. Y. PRD Electronics Div.
ATLAS TEST PROGRAM GENERATOR 2. VOLUME 1: EXECUTIVE SOFTWARE SYSTEM Final Report, Apr. 1978 - Aug. 1980
Jeffrey Kung Aug. 1980 93 p
(Contract DAAB07-78-C-2015)
(AD-A089819; CORADCOM-78-2015-F1) Avail: NTIS HC A05/MF A01 CSCL 09/2

The objective of this project was to design and implement a software processor which would automate the process of generating source code for test programs of various linear analog circuits. The approach used by AGEN (ATLAS Generator) is to take one type of linear analog circuit, e.g., amplifier, and subject it to an in-depth circuit analysis to determine the commonalities among similar types of circuits. Once the commonalities are defined, a circuit model is structured by ATLAS test language through common data base FORTRAN software techniques. The resultant ATLAS model source program is basically a standardized, high quality, error-free ATLAS test program with the variables opened as windows for the AGEN users to insert the values for their individual test specifications. Therefore, the AGEN program is an interactive test program which requires only test specifications from the user to complete the program generations. GRA

N81-11692# Harris Corp., Syosset, N. Y. PRD Electronics Div.
ATLAS TEST PROGRAM GENERATOR 2. VOLUME 2: GENERATOR 2 USERS GUIDE Final Report, Apr. 1978 - Aug. 1980
Jeffrey Kung Aug. 1980 160 p
(Contract DAAB07-78-C-2015)
(AD-A089796; CORADCOM-78-2015-F2) Avail: NTIS HC A08/MF A01 CSCL 09/2

This is the final report on the Army-CORADCOM-sponsored project which had as its objective the design and implementation of a software processor which would automate the process of generating source code for test programs of various linear analog circuits. The approach used by AGEN (ATLAS Generator) is to take one type of linear analog circuit, e.g., amplifier, and subject it to an in-depth circuit analysis to determine the commonalities among similar types of circuits. Once the commonalities are defined, a circuit model is structured by ATLAS test language through common data base FORTRAN software techniques. The resultant ATLAS model source program is basically a standardized, high quality, error-free ATLAS test program with the variables opened as windows for the AGEN users to insert the values for their individual test specifications. Therefore, the AGEN program is an interactive test program which requires only test specifications from the user to complete the program generation. GRA

N81-11693# Maryland Univ., College Park. Computer Science Center.
DATA ABSTRACTION TRANSFORMATIONS Ph.D. Thesis
Mark A. Ardis Aug. 1980 171 p refs
(Contract F49620-80-C-0001)
(AD-A090136; CSC-TR-925; AFOSR-80-1061TR) Avail: NTIS HC A08/MF A01 CSCL 09/2

A data abstraction is a collection of sets together with a collection of operations. Methods exist for specifying and for implementing data abstractions. The central question for any particular example is whether the semantics of each of these two methods corresponds with the intended abstraction. An algebraic comparison of data abstraction specifications and implementations is presented. It is shown that the specified and implemented abstractions always overlap and have a common (lattice) structure that is valuable in understanding the modification of code and specification. A new specification technique, 'table specification', is proposed that emphasizes the underlying congruence-class structure of data abstractions. Algorithms to transform tables are defined. GRA

N81-11694# Maryland Univ., College Park. Dept. of Computer Science.
UNDERSTANDING AND DOCUMENTING PROGRAMS Interim Report
Victor R. Basilt and Harlan D. Mills Apr. 1980 51 p refs
(Grant AF-AFOSR-3181-77; AF Proj. 2304)
(AD-A089739; TR-884; AFOSR-80-0933TR) Avail: NTIS HC A04/MF A01 CSCL 09/2

This paper reports on an experiment in trying to understand an unfamiliar program of some complexity and to record the authors' understanding of it. The goal was to simulate a practicing programmer in a program maintenance environment using the techniques of program design adapted to program understanding and documentation; that is, given a program, a specification and correctness proof were developed for the program. The approach points out the value of correctness proof ideas in guiding the discovery process. Toward this end, a variety of techniques were used: direct cognition for smaller parts, and functions determined by additional analysis for larger program parts. An indeterminate bounded variable was introduced into the program to summarize the effect of several program variables and simplify the proof of correctness. GRA

N81-11695# Syracuse Univ., N. Y. School of Computer and Information Science.
MATHEMATICAL SEMANTICS FOR HIGHER ORDER PROGRAMMING LANGUAGES Final Report, 1 Jun. 1979 - 31 May 1980
Luis E. Sanchis Jul. 1980 75 p refs
(Contract F49620-79-C-0016; AF Proj. 2304)
(AD-A089733; AFOSR-80-0759TR) Avail: NTIS HC A04/MF A01 CSCL 09/2

Complete operational and mathematical semantics are presented for a higher order applicative algorithmic language (BAL). Both semantics involve partially ordered domains closed under limits of convergent sequences. Procedure calls are formalized via lambda calculus reductions, or copy rule. Evaluations involve a more general form of computability described as nondeterministic computability. The mathematical semantics is obtained via embeddings in reflexive domains. Both semantics are proved to be equivalent, and several applications are given. The adequacy of the copy rule is proved in standard situations where computability is deterministic. Several examples are presented. GRA

N81-11696# Delaware Univ., Newark. Dept. of Computer and Information Sciences.
PREREQUISITES TO DERIVING FORMAL SPECIFICATIONS FROM NATURAL LANGUAGE REQUIREMENTS Final Report
Ralph M. Weischedel Aug. 1980 45 p refs
(Contract F49620-79-C-0131; AF Proj. 2304)
(AD-A089711; AFOSR-TR-80-0867TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

This report investigates in a preliminary study whether it is feasible in the foreseeable future to have software tools which under user guidance would aid in developing precise, rigorous specifications from English ones and in detecting ambiguity and vagueness in English specifications. This report identifies four substantial sources of modules which have been specified both in English and a formal language. Portions of one, the specification of KSOS, have been studied under this contract to determine which problems are most formidable for a natural language understanding system. The most difficult problems identified by this report are ambiguity in modifier placement, nominal compounds, quantification, definite reference, and the inference of unstated relationships. Problems that prove not to be as significant are lexical gaps, lexical ambiguity, conjunction, and parenthetical expressions. The work has also identified patterns of English expression in software specification and four areas for further study. Several practical suggestions for better documentation and for more understandable formal specifications are covered at length in a separate report. A sampling of that document is presented. GRA

N81-11697# Colorado Univ. at Boulder. Dept. of Computer Science.
A STRATEGY FOR EFFECTIVE INTEGRATION OF VERIFICA-

TION AND TESTING TECHNIQUES
Leon J. Osterweil Jul. 1980 48 p refs Prepared for publication
(Contract DAAG29-80-C-0094; Grants DAAG29-78-G-0046; NSF MCS-77-02194)
(AD-A089960; CU-CS-181-80; ARO-17124.3-M) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper presents an approach to integrating four techniques for testing, analysis and verification into one overall strategy for incrementally raising confidence in software in a cost effective way. The paper summarizes the strengths, weaknesses, and operational characteristics of dynamic testing, static analysis, symbolic execution and formal verification. It uses a detailed example as an illustration. Next the integrated strategy is presented. Finally, there is a discussion of how this strategy can be used to raise confidence in software requirements and design specifications as well as in code, thereby making it applicable throughout the entire software life cycle. GRA

N81-11698# Science Applications, Inc., Huntsville, Ala.
INTERACTIVE TEXT EDITING FOR THE SIGMA 5 Final Technical Report
S. Kelvin Counselman Sep. 1980 45 p refs
(Contract DAAK40-79-D-0023)
(AD-A089966; SAI-81-739-HU; DRSMI/RG-CR-80-8) Avail: NTIS HC A03/MF A01 CSCL 09/2

An interactive text editor is described which was installed on the Sigma 5 system located in the Guidance and Control Analysis facility at Redstone Arsenal. Use of this processor resulted in a significant decrease in time required to create and update files of symbolic data. It is recommended that this processor be expanded to include capabilities such as to FIND a particular string, to MOVE a line or group of lines to some location, and a capability to define MACRO commands consisting of several edit commands. These enhancements should reduce even further the amount of time required for symbolic data entry and maintenance. E.D.K.

N81-11699# Naval Postgraduate School, Monterey, Calif.
COMPARISON AND ANALYSIS OF SOME ALGORITHMS FOR IMPLEMENTING PRIORITY QUEUES M.S. Thesis
Alinur Goksel Jun. 1980 139 p refs
(AD-A090095) Avail: NTIS HC A07/MF A01 CSCL 12/1

A priority queue is a data structure for maintaining a collection of items, each having an associated key, such that the item with the largest key is easily accessible. Priority queues are implemented by using heap, k-ary tree, single linked-list, leftist tree, linked tree, AVL tree, 2-3 tree and fixed priority property. Required storage for each method was obtained and the worst case time analysis was done in terms of key comparisons and key exchanges during the insertion and deletion process. Finally, each of these methods was run on PDP-11 UNIX TIME SHARING SYSTEM at NPS using different random number generators to get the average CPU time for insertion and deletion process. GRA

N81-11700# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
XLMS: A LINGUISTIC MEMORY SYSTEM
Lowell B. Hawkinson Sep. 1980 57 p refs Sponsored in part by DOD
(Contract N00014-75-C-0661)
(AD-A090033; MIT/LCS/TM-173) Avail: NTIS HC A04/MF A01 CSCL 09/2

LMS ('Linguistic Memory System') is a knowledge representation formalism particularly designed for representing knowledge that can be straightforwardly expressed in natural language. Fundamentally, it is a semantic network formalism, a formalism for managing interconnected objects in a highly-organized, network-like memory. XLMS is a particular LISP-based implementation of LMS, intended primarily for experimental use. GRA

N81-11701# College of William and Mary, Williamsburg, Va. Dept. of Mathematics and Computer Science.
A SURVEY OF BANDWIDTH AND PROFILE REDUCTION ALGORITHMS
Norman E. Gibbs Aug. 1980 21 p refs
(Contract N00014-76-C-0673)
(AD-A090156; TR-22) Avail: NTIS HC A02/MF A01 CSCL 09/2

As of 1980 over 50 bandwidth and/or profile reduction algorithms have appeared in the literature. This paper traces the development of the major reduction algorithms and discusses how automatic reduction algorithms can be compared and evaluated. GRA

N81-11702# Sandia Labs., Livermore, Calif. Exploratory Chemistry Div.
SENSITIVITY EXPERIMENTS: A ONE-SHOT EXPERIMENTAL DESIGN AND THE ASENT COMPUTER PROGRAM
B. E. Mills Aug. 1980 34 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-8216) Avail: NTIS HC A03/MF A01

Sensitivity experiments are commonly used for testing and/or certifying materials such as explosives exposed to stimuli such as sparks. For each sample it is assumed that there is a critical stimulus level above which the result of a test would be positive and below which it would be negative (or vice versa). Methods were developed to minimize the number of samples required by experimental design on the assumption that the response follows a normal distribution and that there are no duds. An experimental design based on the assumptions of a normal distribution and no duds, but which is independent of prior estimates of the mean and the standard deviation, is explained. Monte Carlo experiments were performed using three different types of experimental designs and both good and bad prior estimates of the mean on standard deviation. A computer code is also explained which can be used to give estimates of the mean, the standard deviation and the percentiles (or LDs) based on data from this test design. DOE

N81-11703# Vanderbilt Univ., Nashville, Tenn. Div. of Radiological Sciences.
QUALITY CONTROL OF SOFTWARE IN DISSIMILAR SYSTEMS USING A COMMON CLINICAL DATA BASE
J. J. Erickson, R. R. Price, J. J. Touya, M. W. Kronenberg, R. Pederson, and F. D. Rollo 1980 9 p refs Presented at Intern. Symp. on Med. Radionuclide Imaging, Heidelberg, 1 Sep. 1980
(Contract DE-AS05-80EV-10343)
(DOE/EV-10343/4; CONF-800937-2) Avail: NTIS HC A02/MF A01

There is widespread interest in the quality control of diagnostic instrumentation. The increasing dependence on computational systems for clinical results makes it imperative that methods for quality control of diagnostic software be developed. A method is proposed based on the use of a collection of patient studies for which the results have been corroborated by independent methods. The data set is to be distributed in a format requiring no special handling by the system being tested and is to appear identical to studies actually collected by the host system. An example of the use of a preliminary version of the data set for comparison of two systems is shown. The comparison shows that analyses performed on the two systems agree very well and can be reliably compared for follow-up studies of a patient. DOE

N81-11704# California Univ., Livermore. Lawrence Livermore Lab.
CONTOUR PLOTTING PROGRAMS FOR PRINTER AND CALCOMP PLOTTER
P. Moller Jul. 1980 16 p refs
(Contract W-7405-eng-48)
(UCID-18757) Avail: NTIS HC A02/MF A01

Contour plotting programs for plotting contour diagrams on printers or Calcomp plotters are described. The subroutines also exist in versions that are useful for the special application of finding minima and saddlepoints of nuclear potential energy surface generated by the subroutine PETR3 of another program package. For the general user, however, the most interesting aspect of the plotting package is the possibility of generating printer contour plots. The plotting of printer contour plots is a very fast and convenient way of displaying two dimensional functions. DOE

62 COMPUTER SYSTEMS

Includes computer networks.

N81-11705 Utah Univ., Salt Lake City.
A CONCURRENT PROCESSING SYSTEM FOR LISP Ph.D. Thesis
Jed Benjamin Marti 1980 121 p
Avail: Univ. Microfilms Order No. 8025302

A system in which a small number of processors are connected to form a concurrent asynchronous processor for LISP is described. The machine's design is directed towards the efficient implementation of global variable access. Contemporary LISP programs can be executed without modification in a concurrent environment, generally faster than in a single processor environment. The methods and algorithms for detecting available concurrency are described together with a compiler that instantiates this concurrency in machine instructions. The method is such that the semantics of sequential LISP are preserved. The processors of the network are nodes of a crossbar network. Each processor contains both code and data for execution of multiple tasks. A special processor oversees the dynamic nature of the network and controls function invocation among processors. Dissert. Abstr.

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support*.

N81-11706 Stanford Univ., Calif.
IMPLICIT PROGRAMMING: A METHOD FOR CHARACTERIZING THE ASYMPTOTIC BEHAVIOR OF OPTIMAL CONTROL TRAJECTORIES Ph.D. Thesis
Charles David Feinstein 1980 207 p
Avail: Univ. Microfilms Order No. 8024652

A static method for analysis of the asymptotic behavior of the optimal trajectories of a class of dynamic optimization problems is presented. The class of problems considered is the optimal control problem with discounting, formulated on an infinite time horizon, a class of problems frequently encountered in dynamic economic models. The method is based on the formulation and solution of the Implicit Programming Problem, a static optimization problem that characterizes the optimal steady states of the optimal control problem with discounting. The Implicit Programming Problem represents an indirect approach to the analysis of the full dynamic problem, substituting a static problem for the more difficult dynamic one. Determining the optimal steady states is an important aspect of the analysis of the complete dynamic problem because these points may serve as limit points for other optimal trajectories. In the undiscounted case, it is intuitively clear that the optimal steady state is the steady state that minimizes the kernel of the objective functional. The Implicit Programming Problem indicates that the optimal steady state in the discounted case exhibits similar behavior. Dissert. Abstr.

N81-11707 Arkansas Univ., Fayetteville.
AN INNOVATIONS APPROACH TO DISPLACEMENT ESTIMATION AND IMAGE ANALYSIS IN TIME VARYING IMAGES Ph.D. Thesis
Haroon Ur Rashid 1980 202 p
Avail: Univ. Microfilms Order No. 8026043

An approach is introduced for the development of an image analysis system. The algorithm developed detects motion and estimates the displacement of objects in successive image frames. This algorithm operates on data produced by an adaptive estimation redundancy removal technique and has the added advantage over previously developed algorithms that no frame to frame gradient vector calculation is required. Experimental results are presented for the purpose of comparing the stability of this algorithm with that of other displacement estimation algorithms. In addition to applications in the field of data compression, these results are applied to pattern recognition problems and composite source decomposition. The basic ingredients of an image understanding approach are extracted from a combination of the above applications. The results are discussed quantitatively as well as qualitatively. Dissert. Abstr.

N81-11708# Maryland Univ., College Park. Computer Vision Lab.
A MIN-MAX MEDIAL AXIS TRANSFORMATION
Shmuel Peleg and Azriel Rosenfeld Jan. 1980 14 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090239; TR-856) Avail: NTIS HC A02/MF A01 CSCL 09/4

Blum's Medial Axis Transformation (MAT) of the set S of 1's in a binary picture can be defined by an iterative shrinking and reexpanding process which detects 'corners' on the contours of constant distance from S-bar, and thereby yields a 'skeleton' of S. For unsegmented (gray level) pictures, one can use an analogous definition, in which local MIN and MAX operations play the roles of shrinking and expanding, to compute a 'MMMAT value' at each point of the picture. The set of points having high values defines a good 'skeleton' for the set of high-gray-level points in the given picture. GRA

N81-11709# Maryland Univ., College Park. Computer Vision Lab.
NEIGHBOR FINDING TECHNIQUES FOR IMAGES REPRESENTED BY QUADTREES
Hanan Samet Jan. 1980 55 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090240; TR-857) Avail: NTIS HC A04/MF A01 CSCL 09/4

A number of different techniques are presented for moving between adjacent blocks in an image represented by a quadtree. These adjacencies may be in the horizontal, vertical, or diagonal directions. Algorithms are given and their execution time is analyzed using a suitably defined model. GRA

N81-11710# Maryland Univ., College Park. Computer Vision Lab.
FAST, HIERARCHICAL CORRELATIONS WITH GAUSSIAN-LIKE KERNELS
Peter J. Burt Jan. 1980 59 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090241; TR-860) Avail: NTIS HC A04/MF A01 CSCL 09/2

This paper describes a new method for computing correlations which is particularly well suited for image processing. The method, called hierarchical discrete correlation, or HDC, is computationally efficient, typically requiring two or three orders of magnitude fewer computational steps than direct correlation or correlation computed in the spatial frequency domain using the Fast Fourier transform. In addition the method simultaneously generates correlations for kernels (operators) of many sizes. These kernels closely approximate the Gaussian probability distribution, so that the correlation is equivalent to low pass filtering. The operators commonly used in image processing can be readily obtained from sums and differences of Gaussian-like correlations at nearby image points. GRA

N81-11711# Maryland Univ., College Park. Computer Vision Lab.
USE OF QUADTREES FOR EDGE ENHANCEMENT
Sanjay Ranade Feb. 1980 20 p refs
(Contract DAAG53-76-C-0138; DARPA Order 8206)
(AD-A090242; TR-862) Avail: NTIS HC A02/MF A01 CSCL 09/4

A quadtree approximation of a 2 to the nth power by 2 to the nth power gray level image tends to enhance edges that are strong in the original image and suppress those that are weak. An edge detector applied to such an approximation produces edges that are in general stronger than those obtainable from the original, though slightly displaced. Methods of combining the edge maps obtained from the original image and its quadtree approximation are examined. It is shown that the choice of a suitable combination rule results in an edge map which is superior to that obtainable by conventional means. GRA

N81-11712# Maryland Univ., College Park. Computer Vision Lab.

USE OF QUADTREES FOR IMAGE SEGMENTATION
Sanjay Ranade, Azriel Rosenfeld, and Judith M. S. Rewitt Feb. 1980 21 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090243; TR-878) Avail: NTIS HC A02/MF A01 CSCL 09/4

This paper examines an approach to image segmentation based on using a quadtree approximation image to identify regions in the image. The advantages of this approach are firstly that noise points are not present in the quadtree approximation of an image and secondly that by traversal of the tree it is possible to find the approximate location of the regions within an image. It is thus possible to extract a region by applying thresholds in the vicinity of the region and to identify the best threshold by correlating the extracted region with an edge map of the original image. Since thresholds to extract regions are applied locally, noise points which may be present elsewhere in the edge map have no effect on the correlation of extracted regions to the edge map of the original image. GRA

N81-11713# Maryland Univ., College Park. Computer Vision Lab.
TWO NOTES ON DIGITAL EDGES AND LINES
Les Kitchen, Alan Broder, and Azriel Rosenfeld Mar. 1980 19 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090244; TR-885) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report consists of two independent parts. The first is entitled 'Non-maximum suppression of gradient magnitudes makes them easier to threshold'; it shows that, besides reducing thick responses to thin, the application of non-maximum suppression to digital gradient magnitudes also improves the form of the edge response histogram, making the choice of thresholds easier. In the second, entitled 'A note on collinearity merit', measures of collinearity merit based on distance and angle are defined. They yield reasonable results for edges extracted from an aerial photograph. GRA

N81-11714# Maryland Univ., College Park. Computer Vision Lab.
THRESHOLD SELECTION USING QUADTREES
Angela Y. Wu, Tsai-Hong Hong, and Azriel Rosenfeld Mar. 1980 20 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090245; TR-886) Avail: NTIS HC A02/MF A01 CSCL 05/8

The quadtree representation of binary arrays can be generalized to a quadtree approximation for images. A block is subdivided if its gray level standard deviation is greater than (e.g.) half of the global standard deviation. As a result, small blocks will tend to occur near region borders, and suppressing these blocks deepens the valleys on the image's histogram, thus making it easier to select a threshold for extracting objects from their background in the image. GRA

N81-11715# Maryland Univ., College Park. Computer Vision Lab.
GRAY-LEVEL CORNER DETECTION
Les Kitchen and Azriel Rosenfeld Apr. 1980 24 p refs
(Contract DAAG53-76-C-0138; DARPA Order 3206)
(AD-A090246; TR-887) Avail: NTIS HC A02/MF A01 CSCL 05/8

The usual approach to detecting corners in shapes involves first segmenting the shape, then locating the corners in its boundary. We present several techniques for detecting corners of shapes in gray-level images, without prior segmentation. GRA

N81-11716# Delaware Univ., Newark. Dept. of Mathematical Sciences.
SOME OPTIMAL CONTROL PROBLEMS FOR THE HELMHOLTZ EQUATION Interim Report
Thomas S. Angell Jul. 1980 17 p refs Presented at the Intern. Conf. on Nonlinear Phenomena in Mathematical Sci., Arlington, Tex., 16-20 Jun. 1980
(Grant AF-AFOSR-0085-79; AF Proj. 2304)
(AD-A090176; TR-87A; AFOSR-80-0962TR) Avail: NTIS HC A02/MF A01 CSCL 20/3

Radiation and scattering problems are formulated as optimal control problems in which either a current or surface impedance is sought from a class of admissable functions which optimizes a functional of the scattered far field. In both cases the existence of an optimal solution is proven. In the linear (radiation) case constructive algorithms for finding the optimal solution are presented. GRA

N81-11717# Delaware Univ., Newark. Applied Mathematics Inst.
EXPLICIT STEADY-STATE SOLUTIONS TO SOME ELEMENTARY QUEUEING MODELS Interim Report
Marcel F. Neuts Mar. 1980 23 p refs
(Grants AF-AFOSR-3236-77; NSF ENG-79-08351; AF Proj. 2304)
(AD-A089842; TR-53B; AFOSR-80-0635TR) Avail: NTIS HC A02/MF A01

Several simple queueing models, which are commonly used as textbook examples, have explicit steady-state solutions, which to date have escaped notice. These solutions are easily computable. In addition to their didactic interest, the results, presented here, are also useful in the analysis of more complex queueing models. GRA

N81-11718# Delaware Univ., Newark. Applied Mathematics Inst.
STATIONAY WAITING TIME DISTRIBUTIONS IN THE GI/PH/1 QUEUE Interim Report
Marcel F. Neuts Mar. 1980 12 p refs
(Grants AF-AFOSR-3236-77; NSF ENG-79-08351; AF Proj. 2304)
(AD-A089872; TR-55B; AFOSR-80-0636TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

It is known that the stable GI/PH/i queue has an embedded Markov chain whose invariant probability vector is matrix-geometric with a rate matrix R. In terms of the matrix R, the stationary waiting time distributions at arrivals, at an arbitrary time point and until the customer's departure may be evaluated by solving finite, highly structured systems of linear differential equations with constant coefficients. Asymptotic results, useful in truncating the computations, are also obtained. The queue is assumed to follow the first-come, first-served discipline. GRA

N81-11719# California Univ., San Diego, La Jolla. Center for Human Information Processing.
AN INTERACTIVE ACTIVATION MODEL OF THE EFFECT OF CONTEXT IN PERCEPTION, PART 2 Technical Report, Apr. 1979 - Jul. 1980
James L. McCelland and David E. Rumelhart 15 Jul. 1980 112 p refs
(Contract N00014-79-C-0323; Grants NSF BSN-76-14830; NSF BSN-76-15024; ARPA Order 3767)
(AD-A090189) Avail: NTIS HC A06/MF A01 CSCL 05/8

A number of experiments are presented and it is shown how the model accounts for them. A number of extensions of the model to such cases as spoken input, pronunciation tasks, and words embedded in sentential context are proposed. The strengths and weaknesses of the model are discussed pointing out further possible extensions of the model to account for aspects of word perception currently ignored. The experiments all revolve around what is called the context enhancement effect. These experiments are designed to assess the roles of direct and indirect evidence concerning the identity of a letter in an input string. E.D.K.

N81-11720# Brown Univ., Providence, R. I.
COMPUTATIONAL DIFFICULTIES IN THE IDENTIFICATION AND OPTIMIZATION OF CONTROL SYSTEMS Interim Report
H. T. Banks Jan. 1980 23 p refs Presented at Workshop on Appl. Control Theory to Renewable Resource Management and Ecol., Univ. of Canterbury, Christchurch, New Zealand, 7-11 Jan. 1980
(Grants DAAG29-79-C-0161; AF-AFOSR-3092-76; NSF MCS-79-05774; AF Proj. 2304)
(AD-A089845; AFOSR-80-0634TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

As more realistic models for resource management are

developed, the need for efficient computational techniques for parameter estimation and optimal control involving nonlinear vector systems will grow. This report discusses some of the difficulties associated with such computational schemes and also reports on results available for identification and control of several classes of systems which are of increasing importance in a number of areas of applications. GRA

N81-11721# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
REPRESENTATION AND ANALYSIS OF REAL-TIME CONTROL STRUCTURES M.S. Thesis
Rowland F. Archer, Jr. Aug. 1980 113 p refs
(Contract N00014-75-C-0661)
(AD-A089828; MIT/LCS/TR-241) Copyright. Avail: Issuing Activity CSCL 09/2

A new notation is introduced for representing real-time scheduling at the task and event level. These schedules are called control structures. The primary constructs included which direct the flow of control are sequencing, iteration, and preemption. Additional notation allows the representation of interrupt masking, task termination by external events, task restart as well as resumption from the point of preemption and codestripping. Algorithms are given for finding the preemption structure of a given control structure in the notation. The types of representable control structures are classified by the topology of their Control Flow Graphs. A terminology for describing real-time properties of control structures is developed, and it is seen that without certain assumptions about task execution times and event timings, conclusions cannot be drawn regarding real-time performance of a control structure. A series of algorithms is presented which make use of these assumptions, and find values for task execution times in the presence of preemption. The algorithms can analyze control structures containing the principal control features; suggestions are given for further development of algorithms which can analyze any representable control structure. GRA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N81-11722 University of Northern Colorado, Greeley.
THE THEORY AND APPLICATIONS OF INFINITE PRODUCTS OF COMPLEX VARIABLES Ph.D. Thesis
John Robert Hunt 1980 122 p
Avail: Univ. Microfilms Order No. 8023884

A comprehensive presentation of the classical theory of complex infinite products is presented along with both an extensive collection of examples illustrating the theory and a selection of the numerous applications of infinite products other areas of mathematics. The theroetical development includes a thorough presentation of the topics of infinite products of complex numbers and of analytic functions with special attention devoted to the concepts of convergence, conditional convergence, absolute convergence, uniform convergence, and divergence of such products. The numerical examples serve to illustrate the relationships that exist, or that fail to exist, between the different types of convergence. Also, representation theorems as applied to entire functions, and the representation of functions analytic on the open unit disk are addressed. The theory is applied to obtain the infinite product representations of the functions sin(piz), cos(piz), and the Riemann zeta function Zeta(z). Further applications of infinite products are presented in the material on representing constants as infinite products. The methods are applied to the field of number theory through the presentation of certain topics taken from the theory of partitions.
Dissert. Abstr.

N81-11723*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SOLUTION OF ONE DIMENSIONAL FREDHOLM INTEGRAL EQUATIONS OF THE SECOND KIND
Ralph E. Gabrielsen Nov. 1980 13 p refs Prepared in cooperation with Army Aviation Research and Development Command, St. Louis
(NASA-TM-81195; A-8165; USAAVRADCOM-TR-81-A-1) Avail: NTIS HC A02/MF A01 CSCL 12A

Fredholm integral equations of the second kind of the one dimension are numerically solved. It is proven that the numerical solution converges to the exact solution of the integral equation. This is shown for periodic kernels and then extended to nonperiodic kernels. This development helps delineate a basic theory which has the potential of solving very complex problems. S.F.

N81-11724# Wisconsin Univ. - Madison.
IMPLICIT DEGENERATE EVOLUTION EQUATIONS AND APPLICATIONS
Emmanuele Dibenedetto and R. E. Showalter (Texas Univ., Austin) Jul. 1980 41 p refs
(Contracts DAAG29-80-C-0041; DAAG29-75-C-0024; Grant NSF MCS-78-09525)
(AD-A089637; MRC-TSR-2099) Avail: NTIS HC A03/MF A01 CSCL 12/1

The initial-value problem is studied for evolution equations in Hilbert space of the general form d/dt A(u) - B(u) not an element of f where A and B are maximal monotone operators. Existence of a solution is proved when A is a subgradient and either A is strongly-monotone or B is coercive; existence is established also in the case where A is strongly-monotone and B is subgradient. Uniqueness is proved when one of A or B is continuous self-adjoint and the sum is strictly-monotone; examples of nonuniqueness are given. Applications are indicated for various classes of degenerate nonlinear partial differential equations or systems of mixed elliptic-parabolic-pseudoparabolic types and problems with non-local nonlinearity. GRA

N81-11725# Wisconsin Univ. - Madison. Mathematics Research Center.
COLLOCATION APPROXIMATION TO EIGENVALUES OF AN ORDINARY DIFFERENTIAL EQUATION: NUMERICAL ILLUSTRATIONS
Carl DeBoor and Blair Swartz May 1980 32 p refs
(Contracts DAAG29-80-C-0041; DAAG29-75-C-0024; W-7405-eng-36)
(AD-A089633; MRC-TSR-2080) Avail: NTIS HC A03/MF A01 CSCL 12/1

We display the numerical results associated with the collocation of three eigenvalue problems using from one to four Gauss points per partition interval in order to document the sharpness of the error bounds we have previously obtained. The ordinary differential operators involved are real with constant coefficients; two of the problems have an eigenvalue whose ascent exceeds one. We propose an explanation for the observed manner in which a set of simple approximate eigenvalues can approach a single multiple eigenvalue. GRA

N81-11726# Wisconsin Univ. - Madison. Mathematics Research Center.
ON LOCAL LINEAR FUNCTIONALS FOR L-SPLINES
Rong-Qing Jia Jun. 1980 18 p refs
(Contract DAAG29-80-C-0041)
(AD-A089667; MRC-TSR-2094) Avail: NTIS HC A02/MF A01 CSCL 12/1

Quasi-interpolant functionals for L-splines are constructed. With them as a tool, an explicit construction of LB-splines is done, and a quick proof of the existence and uniqueness of the expansion of an L-spline in an LB-spline series is given. Moreover, a necessary and sufficient condition for a function, under which it generates a local linear functional that vanishes at all LB-splines but one, is obtained. GRA

N81-11727# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
COVARIANCE SEQUENCE APPROXIMATION FOR PARAMETRIC SPECTRUM
Louis L. Scharf and A. A. Louis Beex (Virginia Polytechnic Inst. and State Univ., Blacksburg) Aug. 1980 35 p refs
(Contract N00014-75-C-0518)
(AD-A089680; CSU-TR-AUG80-1) Avail: NTIS HC A03/MF A01 CSCL 12/1

Parametric methods of spectrum analysis are founded on finite-dimensional models for covariance sequences. Rational

spectrum approximants for continuous spectra are based on autoregressive (AR), moving average (MA), or autoregressive moving average (ARMA) models for covariance sequences. Line spectrum approximants to discrete spectra are based on cosinusoidal models for covariance sequences. In this paper we make the point that a wide variety of spectrum types admit to modal analysis wherein the modes are characterized by amplitudes, frequencies, and damping factors. The associated modal decomposition is appropriate for both continuous and discrete components of the spectrum. The domain of attraction for the decomposition includes ARMA sequences, harmonically or nonharmonically related sinusoids, damped sinusoids, white noise, and linear combinations of these. The parametric spectrum analysis problem now becomes one of identifying mode parameters. We achieve this by solving two modified least squares problems. Numerical results are presented to illustrate the identification of mode parameters and corresponding spectra from finite records of perfect and estimated covariance sequences. The results for sinusoids and sinusoids in white noise are interpreted in terms of in-phase and quadrature effects attributable to the finite record length. GRA

N81-11728# Delaware Univ., Newark. Applied Mathematics Inst.

BOUNDARY INTEGRAL EQUATIONS FOR THE HELMHOLTZ EQUATION: THE THIRD BOUNDARY VALUE PROBLEM Interim Technical Report

T. S. Angell and R. E. Kleinman 1980 61 p refs
(Grant AF-AFOSR-0085-79; AF Proj. 2304)
(AD-A089921; TR-73A; AFOSR-80-0964TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

The third boundary value problem, or Robin problem, for the Helmholtz equation in an exterior domain in R3 may be cast with Green's theorem, as a boundary integral equation. This equation is not equivalent to the original problem because it has eigenvalues at wave numbers for which the exterior problem is soluble. However, a second boundary equation is derived and it is shown that the pair is equivalent to the original boundary value problem. GRA

N81-11729# Stanford Univ., Calif. Dept. of Computer Science.

ALGORITHMS IN MODERN MATHEMATICS AND COMPUTER SCIENCE

Donald E. Knuth Jan. 1980 28 p refs
(Contract N00014-76-C-0330; Grant NSF MCS-72-03752)
(AD-A089912; SU-STAN-CS-80-786) Avail: NTIS HC A03/MF A01 CSCL 12/1

The life and work of the ninth century scientist al-Khwarizmi, 'the father of algebra and algorithms,' is surveyed briefly. Then, a random sampling technique is used in an attempt to better understand the kinds of thinking that good mathematicians and computer scientists do and to analyze whether such thinking is significantly 'algorithmic' in nature. GRA

N81-11730# Stanford Univ., Calif. Dept. of Computer Science.

NUMERICAL LINEAR ALGEBRA Interim Report, 1 Feb. 1979 - 31 Mar. 1980

Gene H. Golub, James H. Wilkinson, Paul VanDooren, and Daniel L. Boley 8 Sep. 1980 9 p refs
(Grant AF-AFOSR-0094-79; AF Proj. 2304)
(AD-A090053; AFOSR-80-0874TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Research in this program has concentrated on the generalized eigenvalue problem and its natural extension to the computation of the associated canonical form. Furthermore, there has been an extensive effort to study the matrix equation arising in control engineering such as controllability observability decomposition and the solution of the Riccati equations. In particular, error bounds for the computed eigenvalues and eigenvectors of the generalized eigenvalue problem have been devised. In addition, a numerically stable algorithm has been developed for computing the orthonormal bases for deflating subspace of a regular pencil. A method has been developed to obtain any desired ordering of eigenvalues in the quasi-triangular forms. GRA

N81-11731# Stanford Univ., Calif. Systems Optimization Lab.

VARIABLE-DIMENSION COMPLEXES WITH APPLICATIONS

Robert M. Freund Jun. 1980 139 p refs
(Contracts DE-AC03-76SF-00326; DE-AT03-76ER-72018; Grants DAAG29-78-G-0026; NSF MCS-79-03145; NSF SOC-78-16811)
(AD-A089990; SU-SOL-80-11; ARO-15254.8-M) Avail: NTIS HC A07/MF A01 CSCL 12/1

In the past few years, researchers in fixed-point methods have developed a number of variable-dimension simplicial algorithms. These algorithms are shown to be specific realizations of pivoting methods on a V-complex. The concept of a V-complex is also used to give new and constructive proofs of a variety of known theorems in combinatorial topology and mathematical programming. Finally, V-complexes give rise to new theorems in complementarity theory and combinatorial topology, including a generalization of the Sperner Lemma, a covering theorem on the simplex, and a new combinatorial lemma on n-cube. GRA

N81-11732# Brown Univ., Providence, R. I. Lefschetz Center for Dynamical Systems.

SPLINE APPROXIMATION FOR AUTONOMOUS NONLINEAR FUNCTIONAL DIFFERENTIAL EQUATIONS Interim Report

Franz Kappel 18 Jun. 1980 23 p refs
(Contract DAAG29-79-0161; AF-AFOSR-3092-76; AF Proj. 2304)
(AD-A089846; AFOSR-80-0862TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Based on abstract approximation results in semigroup theory, an approximation scheme for nonlinear autonomous functional-differential equations with globally Lipschitzean right-hand side was developed. The scheme can be realized by using spline approximation of the state. GRA

N81-11733# Oakland Univ., Rochester, Mich. School of Engineering.

A FAULT-DIAGNOSIS TECHNIQUE FOR CLOSED FLOW NETWORKS

K. Matsui (National Defense Academy, Yokosuka, Japan) and D. K. Pradhan Jun. 1980 18 p refs
(Contract F49620-79-C-0119; AF Proj. 2304)
(AD-A089689; AFOSR-80-0951TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Closed flow networks represent a mathematical model for transportation networks multiple resource computer systems and computer communication networks. A fault-diagnosis technique for these networks is presented which can locate all single edge failures in the network. This technique is based on a flow casualty relationship developed here. The number of edges that need to be monitored is shown to be (n-1) for an n-node network. These edges constitute the branches of a tree in the network. GRA

N81-11734# Pittsburgh Univ., Pa. Inst. for Statistics and Applications.

A MULTIVARIATE CORRELATION RATIO Interim Report

Allan R. Sampson May 1980 26 p refs
(Contract F49620-79-C-0161; AF Proj. 2304)
(AD-A089763; TR-80-6; AFOSR-80-0938TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

A brief review of the historical background and certain known results concerning the univariate correlation ratio are given. A multivariate correlation ratio of a random vector Y upon a random vector X is defined, where A is a given positive definite matrix. The properties of ETA sub A are discussed, with particular attention paid to a 'correlation-maximizing' property. A number of examples illustrating the application of ETA sub A are given; these examples include the multivariate normal, the elliptically symmetric distributions, the Farlie-Morgenstern-Gumbel family, and the multinomial. The problem of maximizing ETA sub A (BY;X) over suitable matrices B is considered and the results that are obtained are related to canonical correlations for the multivariate normal. GRA

N81-11735# Pittsburgh Univ., Pa. Inst. for Statistics and Applications.

SIMULTANEOUS PSEUDO CONFIDENCE REGIONS FOR RATIOS OF THE DISCRIMINANT COEFFICIENTS Interim Report

Yasuko Chikus Jul. 1980 24 p refs Prepared in cooperation with Kagawa Univ., Japan

(Contract F49620-79-C-0161; AF Proj. 2304)

(AD-A090182; TR-80-7; AFOSR-80-0939TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

We consider simultaneous confidence regions for some hypotheses on ratios of the discriminant coefficients of the linear discriminant function when the population means and common covariance matrix are unknown. This problem, involving hypotheses on ratios, yields the so-called 'pseudo' confidence regions valid conditionally in subsets of the parameter space. We obtain the explicit formulae of the regions and give further discussion on the validity of these regions. Illustrations of the pseudo confidence regions are given. GRA

N81-11736# Dayton Univ., Ohio.

APPLICABILITY OF THE FINITE ELEMENT CONCEPT TO HYPERBOLIC EQUATIONS Interim Report, May - Oct. 1979

Karl G. Guderley and Donald S. Clenn (AFWAL, Wright-Patterson AFB, Ohio) Jun. 1980 152 p refs

(Grant AF-AFOSR-3524-78; AF Proj. 2304)

(AD-A089774; UDR-TR-79-109; AFWAL-TR-80-3048) Avail: NTIS HC A08/MF A01 CSCL 12/1

The report analyzes by means of examples the applicability of the finite element method (in the form of a weighted residual approach) to hyperbolic equations, using rectangular elements and bi-linear, bi-quadratic or bi-cubic shape functions. For sinusoidal initial conditions the errors are discussed for semi and fully discretized approximating equations. All methods have appreciable errors if the wave lengths are short. For semi-discretized methods, higher order elements give more accurate results at intermediate wave lengths. The fully discretized version for cubic elements becomes unstable, unless it is carried out as a combination of collocation and weighted residual methods. An example of a different kind shows the character of perturbations as one approaches the sonic line. A rationale for the choice of weight functions can be obtained by relating them to the Green's function. In two dimensional problems, one can improve the cancellation of long distance effects of truncation errors by choosing characteristics as element boundaries. GRA

N81-11737# Michigan Univ., Ann Arbor. Computer, Information and Control Engineering Program.

POISSON FLOWS ON MARKOV STEP PROCESS

Frederick J. Beutler and Benjamin Melamed (Northwestern Univ., Evanston, Ill.) Dec. 1979 24 p refs

(Grants AF-AFOSR-2903-76; NSF ENG-75-20223)

(AD-A089738; AFOSR-80-0922TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A Markov step process Z equipped with a possible non-denumerable state space x can model a variety of queueing, communication and computer networks. The analysis of such networks can be facilitated if certain traffic flows consist of mutually independent Poisson processes. A multivariate N is Poisson (i.e., composed of mutually independent Poisson streams N sub i) if each r sub i (Z) is stationary, and r sub i(Z(t)) is independent of N(t) for each i and each t greater than or = 0. The latter is already much less restrictive than the independent of N(t) and Z(t), but it is able to find even weaker hypotheses which are both necessary and sufficient for N to be Poisson. GRA

N81-11738# Sandia Labs., Albuquerque, N. Mex.

COMPARISON OF THERMOMECHANICAL CALCULATIONS FOR HIGHLY NONLINEAR QUASISTATIC DRIFT DEFORMATIONS

J. Robert Wayland and Larry D. Bertholf Jul. 1980 64 p refs

(Contract DE-AC04-76DP-00789)

(SAND-80-0149) Avail: NTIS HC A04/MF A01

The results from five different codes (COUPLEFLO, JAC, SANCHO, SPECTROM, and STEALTH) are given for a problem involving the creep closure of an underground drift. The basic features of the codes are summarized and the codes are evaluated in terms of their applicability to radioactive waste isolation problems. The codes predicted essentially the same response for this problem, and they appear to be nearly equally applicable to problems of this type. Also, a new benchmark problem is suggested along with a more realistic creep model for bedded salt. DOE

N81-11739# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.

LANCZOS ALGORITHM FOR SYMMETRIC EIGENVALUE PROBLEMS

D. S. Scott 1980 25 p Presented at Conf. on Sparse Matrices and Their Uses, Reading, England, 9 Jul. 1980

(Contract W-7405-eng-26)

(CONF-800733-1) Avail: NTIS HC A02/MF A01

The Lanczos algorithm was originally used to tridiagonalize symmetric matrices, but was soon replaced by more effective methods based on explicit orthogonal similarity transformations. The algorithm was later revived as an effective scheme for solving sparse symmetric eigenvalue problems. The historical development and the current state of the Lanczos algorithm are surveyed. DOE

N81-11740# Princeton Univ., N. J. Plasma Physics Lab.

SIMULTANEOUS ACCELERATED RELAXATION METHOD FOR ELLIPTIC EQUATIONS

S. C. Jardin and A. Miller Jul. 1980 7 p refs

(Contract DE-AM02-76CH-03073)

(PPPL-1687) Avail: NTIS HC A02/MF A01

A physically motivated iterative method is presented for solving elliptic equations. The method is shown to converge 3 to 4 times as fast as the optimal successive over-relaxation method when implemented on the CRAY-1 computer. DOE

N81-11741# Argonne National Lab., Ill.

APPLIED MATHEMATICAL SCIENCES RESEARCH AT ARGONNE, 1 OCT. 1978 - 31 MAR. 1980

Gail W. Pieper 1980 39 p

(Contract W-31-109-eng-38)

(ANL-80-42) Avail: NTIS HC A03/MF A01

Activities in four major areas of research (applied analysis, computational mathematics, software engineering, and software clinics) are briefly reported. DOE

N81-11742# Oak Ridge National Lab., Tenn. Fusion Energy Div.

CALCULATION OF SIMILARITY SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS

L. Dresner Aug. 1980 34 p refs

(Contract W-7405-eng-26)

(ORNL/TM-7407) Avail: NTIS HC A03/MF A01

When a partial differential equation in two independent variables is invariant to a group G of stretching transformations, it has similarity solutions that can be found by solving an ordinary differential equation. Under broad conditions, this ordinary differential equation is also invariant to another stretching group G', related to G. The invariance of the ordinary differential equation to G' can be used to simplify its solution, particularly if it is of second order. Then a method of Lie's can be used to reduce it to a first order equation, the study of which is greatly facilitated by analysis of the direction field. The method developed here is applied to three examples: Blasius's equation for boundary layer flow over a flat plate and two nonlinear diffusion equations. DOE

N81-11743# Oak Ridge National Lab., Tenn. Computer Sciences Div.

COMPUTATIONAL EXPERIENCE WITH AN EXPLICIT DIFFERENCE SCHEME FOR A ONE PHASE STEFAN PROBLEM

Neil Eklund, Alan Solomon, and D. G. Wilson Jul. 1980 32 p refs

(Contract W-7405-eng-26)

(ORNL/CSD-62) Avail: NTIS HC A03/MF A01

The results of a computational scheme of Rose (a method for calculating solutions of parabolic equations with free boundary)

are compared with the known analytic solution of a single phase Stefan problem with constant boundary temperature. Rose's scheme was implemented in FORTRAN on a DEC PDP-10. Computations were performed for Stefan numbers St = 0.01, 0.1, 1, 10, and 100. Three relative mesh sizes (gamma = DT/(DX) squared = 1/2, 1/6, and 1/25) were used. For each St, the relative mesh size had very little effect on accuracy. However, taking gamma = 1/25 resulted in dramatically increased computing time. The relative errors of temperature were large near the phase change front. DOE

N81-11744# Oak Ridge National Lab., Tenn. Computer Sciences Div.
SOME PROPERTIES OF THE LOG-LAPLACE DISTRIBUTION
V. R. R. Uppuluri Aug. 1980 13 p refs
(Contract W-7405-eng-26)
(ORNL/CSD/TM-68) Avail: NTIS HC A02/MF A01

A random variable gamma is said to have the Laplace distribution or the double exponential distribution whenever its probability density function is given by gamma exp (-gamma absolute value (y)), where - infinity < Y < infinity and gamma > 0. The random variable X = exp(gamma) is said to have the log-Laplace distribution. With the problem of extrapolation to low doses in dose response curves as a motivation, an axiomatic characterization of the log-Laplace distribution is obtained. DOE

N81-11745# Sandia Labs., Albuquerque, N. Mex. Numerical Mathematics Div.
MULTIPLE PRECISION INTEGER OPERATION PACKAGE
Richard J. Hanson May 1980 33 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-1146) Avail: NTIS HC A03/MF A01

A package of FORTRAN codes was developed for certain multiple precision integer operations. These operations include basic arithmetic, modular exponentiation, and conversion of numbers to and from decimal representation. Reliability of the results was maintained by cross-checking both the lengths of internal working storage arrays against the requirements of the operations, and the size and sign of the internal representation of the digits. DOE

N81-11746# Brookhaven National Lab., Upton, N. Y.
NUMERICAL METHOD FOR SOLVING ELLIPTIC BOUNDARY VALUE PROBLEMS IN UNBOUNDED DOMAINS
C. I. Goldstein Jul. 1980 8 p refs Presented at Elliptic Probl. Solvers Conf., Santa Fe, N. Mex., 30 Jun. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28138; CONF-800699-1) Avail: NTIS HC A02/MF A01

A numerical method for solving elliptic boundary value problems in unbounded domains is described. An artificial boundary near infinity, say a sphere gamma sub R of large radius R, and an approximate local boundary condition on gamma sub R are introduced. A finite element method is then employed to discretize this approximate problem. Since R must be large in order to estimate the error due to the artificial boundary, the resulting system of linear equations is usually quite large. A description is given on how to reduce the number of linear equations to the asymptotically optimal amount, while optimal error estimates and the sparseness of the matrix are preserved, by grading the mesh systematically in such a way that the element mesh sizes are increased as the distance from the origin increases. Some numerical results are given. DOE

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N81-11747*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
A BOUND FOR THE SMOOTHING PARAMETER IN CERTAIN WELL-KNOWN NONPARAMETRIC DENSITY ESTIMATORS
George R. Terrel Apr. 1980 9 p refs
(Contract NAS9-15800)
(NASA-CR-160657; LEMSCO-14850; JSC-16669) Avail: NTIS HC A02/MF A01 CSCL 12A

Two classes of nonparametric density estimators, the histogram and the kernel estimator, both require a choice of smoothing parameter, or 'window width'. The optimum choice of this parameter is in general very difficult. An upper bound to the choices that depends only on the standard deviation of the distribution is described. Author

N81-11748# Maryland Univ., College Park. Computer Science Center.
STOCHASTIC MODELS FOR CLOSED BOUNDARY ANALYSIS. PART 1. REPRESENTATION AND RECONSTRUCTION Interim Report
R. L. Kahyap (Purdue Univ., Lafayette, Ind.) and R. Chellappa Jul. 1980 57 p refs
(Grants AF-AFOSR-3271-77; NSF ENG-78-18271; AF Proj. 2304)
(AD-A089843; TR-909; AFOSR-80-0946TR) Avail: NTIS HC A04/MF A01 CSCL 09/2

This paper deals with the analysis of closed boundaries of arbitrary shape in a plane. Specifically, it is concerned with the problems of representation and reconstruction. We first set up a one to one correspondence between the given closed boundary and a univariate or multivariate sequence of real numbers. Univariate or multivariate circular autoregressive models are suggested for the representation of the sequence of numbers derived from the closed boundary. The stochastic model representing the closed boundary is invariant to transformations of the boundary such as scaling, rotation and choice of the starting point. Methods for estimating the unknown parameters of the model are given and a decision rule for choosing the appropriate order of the model is included. Constraints on the estimates are derived so that the estimates are invariant to transformations of the boundaries. The specific stochastic model used enables us to reconstruct a closed boundary with less computational effort using FFT algorithms. Results of simulations are included and applications to contour coding are discussed. In a subsequent paper we will consider the classification problem. GRA

N81-11749# Indiana Univ. at Bloomington. Dept. of Mathematics.
ASYMPTOTIC NORMALITY OF SINGED RANK STATISTICS WITH DISCONTINUOUS SCORE GENERATING FUNCTION Interim Report
Madan L. Puri Aug. 1980 29 p refs
(Grant AF-AFOSR-2927-76; AF Proj. 2304)
(AD-A090180; AFOSR-80-0869TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The object of this paper is to derive the asymptotic distributions of simple linear signed rank statistic considered by Hajek (1968) and Huskova (1970) for the case when the score generating function is discontinuous. GRA

N81-11750# South Carolina Univ., Columbia. Dept. of Mathematics and Statistics.
APPROXIMATION PREDICTION INTERVALS FOR A FUTURE OBSERVATION FROM THE INVERSE GAUSSIAN DISTRIBUTION Interim Report
W. J. Padgett Aug. 1980 18 p refs
(Contract F49620-79-C-0140; AF Proj. 2304)
(AD-A089927; TR-65; AFOSR-80-0959TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The problem of predicting, on the basis of an observed sample from an inverse Gaussian distribution, the mean of a future random sample (or a single future observation) from the same distribution is considered. Approximate prediction intervals are proposed, and their accuracy is investigated via extensive Monte Carlo simulations. The results are useful for predicting the next first passage time for a Brownian motion with positive drift or the failure time of an item having inverse Gaussian life distribution. GRA

N81-11751# South Carolina Univ., Columbia. Dept. of Mathematics and Statistics.
ESTIMATION OF THE RATIO OF SCALE PARAMETERS IN

THE TWO SAMPLE PROBLEM WITH ARBITRARY RIGHT CENSORSHIP Interim Report
W. J. Padgett and L. J. Wei Jun. 1980 14 p refs
(Contract F49620-79-C-0140; AF Proj. 2304)
(AD-A089925; TR-60; AFOSR-80-0960TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A two-sample version of the Cramer-von Mises statistic for right censored observations is used to obtain an estimator of the ratio of scale parameters of two distributions. It is shown that this estimator is consistent. For small samples, simulations are performed which show the superiority of the estimator over the maximum likelihood estimator for exponential distributions.
GRA

N81-11752# Florida Univ., Gainesville. Dept. of Statistics.
ON THE IDENTIFIABILITY OF MULTIVARIATE LIFE DISTRIBUTION FUNCTIONS
Naftali A. Langberg and Moshe Shaked (Indiana Univ., Bloomington) Jul. 1980 22 p refs
(Grants AF-AFOSR-3678-78; NSF MCS-79-27150; AF Proj. 2304)
(AD-A089799; FSU-STATISTICS-M553; AFOSR-78-114TR; AFOSR-80-0940TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

By observing a series system of d components one can only determine its lifelength and the components that cause the system to fail. In particular the lifelength of a series system that consists of a nonempty subset of the original d components is unobservable. The distribution function (d.f.) of the lifelength of this series system is referred to as an unobservable d.f. For example, some of the original d components, such as wires and switches, may be placed in the system to support the operation of the main components. The d.f. of the lifelength of the series system that consists only of the main components is of great importance to the theory of engineering reliability but is unobservable.
E.D.K.

N81-11753# Florida State Univ., Tallahassee. Dept. of Statistics.
TESTS FOR MONOTONE MEAN RESIDUAL LIFE USING RANDOMLY CENSORED DATA Interim Report
Yuan Yan Chen, Myles Hollander, and Naftali A. Langberg Jul. 1980 21 p refs
(Grant AF-AFOSR-3678-78; AF Proj. 2304)
(AD-A089713; FSU-STATISTICS-M549; AFOSR-78-111TR; AFOSR-80-0944TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The means residual life (mrl) function gives the expected remaining life of a patient at an age X, where the underlying failure distribution is F. Reliabilists and biometricians have found it useful to categorize failure distributions by monotonicity properties of the mrl. The mrl is a function of central importance in reliability, biometry, and other disciplines where survivorship studies arise.
E.D.K.

N81-11754# Brown Univ., Providence, R. I.
EXPONENTIAL LEVELING FOR STOCHASTICALLY PERTURBED DYNAMICAL SYSTEMS Interim Report
Martin Day Jun. 1980 26 p refs
(AF-AFOSR-3063-76; AF Proj. 2304)
(AD-A090169; AFOSR-80-0871TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper considers solutions of a differential equation in a bounded domain which is bounded in epsilon = 0. Assumptions are made that all solutions of the ODE converge to a single linearly asymptotically stable critical point in omega without leaving omega. Proof is given based on the standard probabilistic interpretation of u to epsilon power, of an exponential leveling property.
GRA

N81-11755# SKF Industries, Inc., King of Prussia, Pa.
TWO-WAY ANALYSIS OF VARIANCE FOR WEIBULL POPULATIONS Final Scientific Report, 30 Dec. 1978 - 31 Jul. 1980
John I. McCool Aug. 1980 68 p refs
(Contract F49620-79-C-0035; AF Proj. 2304)
(AD-A090170; SKF-AT80D048; AFOSR-80-0999TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

Expressions are given for the maximum likelihood estimators of the Weibull shape parameter using data from a two-way classification experiment under five hypothesized relationships for the scale parameter in each cell, viz, the scale parameter (1) is constant, (2) has a multiplicative row effect, (3) has a multiplicative column effect, (4) has a multiplicative row and column effect, and (5) has multiplicative row and column and interaction effects. Procedures for analyzing a two-way layout without interaction (a randomized block design) are discussed and illustrated. Techniques are given for estimation of, and inference on, the location parameter of the three-parameter Weibull distribution and a military application of the technique is given. Software improvements are cited in the Monte Carlo simulation computer program for the computation of the distributions of pivotal functions required for analyzing Weibull regression experiments.
GRA

N81-11756# Illinois Univ. at Chicago Circle, Chicago. Dept. of Mathematics.
CONTROLLED PROBABILITY PROPORTIONAL TO SIZE SAMPLING DESIGNS Interim Report
A. Hedayat and B. Y. Lin Jul. 1980 27 p refs
(Grant AF-AFOSR-3050-79; AF Proj. 9769)
(AD-A090134) Avail: NTIS HC A03/MF A01 CSCL 12/1

Any sampling design, d, of size n without replacement based on a finite population U of N units or strata can be formally presented by a pair (s sub d, P sub d), where S sub d called the support of d, is any set of subsets of size n each based on the elements of U such that the (set theoretic) union of these subsets, called samples, is U and P sub d is a strictly positive probability distribution on S sub d. A sampling design is said to be a probability proportional to size, denoted by PPS(N,n), if the probability that the unit i is being selected in a random sample is proportional to a known positive quantity associated with the unit i - 1,2,...,N. The literature of survey sampling offers A PPS(N,n) with S sub d consisting of all (N or n) possible samples. An easily applicable technique for the construction of PPS(N,n) with various support sizes and various probabilities on each support is given. Such sampling designs are needed for controlled samplings when some samples are undesirable to be chosen or it is necessary to minimize (or maximize) the probabilities of the selection of certain samples.
M.G.

N81-11757# Purdue Univ., Lafayette, Ind. Purdue Electric Power Center.
FORECASTING ONE-STEP-AHEAD HIGHER ORDER STATISTICAL MOMENTS AND PROBABILITY DENSITY FUNCTIONS FOR POWER SYSTEM LOADS USING LEAST SQUARES ESTIMATORS Ph.D. Thesis
Alireza Khotanzad May 1980 145 p refs
(Contract DE-AS02-77ET-29102; EC-77-S-02-4345)
(PCTR-94-80; TR-EE-80-19) Avail: NTIS HC A07/MF A01

Conventional load forecasting involves the prediction of the expected value of the demand of an electric power system. The expected value of a quantity which is subject to uncertainty does not fully characterize that quantity. The one step ahead load value is calculated using a least square estimator which relies on previous load measurements. Subsequently, the load values are treated as an ensemble of random variables with calculable statistical moments. Calculating these moments permits predicting the entire one step ahead probability density function of the load using Gram-Charlier series Type A. From this density function, a wide variety of statistical quantities may be calculated: the mean value, the probability that the load will exceed some threshold, conditional probabilities (under special conditions such as negative generation margin), and conditional expectations.
DOE

N81-11758# Purdue Univ., Lafayette, Ind. Electric Power Center.
FORECASTING HIGHER ORDER STATISTICAL MOMENTS AND PROBABILITY DENSITIES FOR POWER SYSTEM LOADS BY THE METHOD OF TIME SERIES Thesis
Nader Farahbakhshian May 1980 119 p refs
(Contracts DE-AS02-77ET-29102; EC-77-S-02-4345)
(PCTR-92-80; TR-EE-80-18) Avail: NTIS HC A06/MF A01

Demand forecasting of electric power system loads was conventionally done by prediction of the expected value of the

demand. This mean value being subject to uncertainty does not fully characterize the quantity demanded since a stochastic process is not fully characterized by its expected value. In this thesis, not only the mean value but also the probability density function of power system loads are obtained. In achieving this goal the method of time series is used to predict the mean value and consequently the higher statistical moments. The latter is then used in a Gram-Charlier series to obtain the probability density function of the electrical power system loads. From this density function a wide variety of quantities may be calculated, namely, the mean value, the probability of the load exceeding some threshold, conditional probabilities, conditional expectation, and a figure of confidence of the forecasted mean. An example is given in which data from an actual electrical load are used. DOE

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N81-11759 Kansas State Univ., Manhattan.
SYSTEM EFFECTIVENESS MODELS VIA RENEWAL THEORY AND BAYESIAN INFERENCE Ph.D. Thesis
Way Kuo 1980 536 p
Avail: Univ. Microfilms Order No. 8024256

System effectiveness, the probability that a system can successfully meet an operational demand within a given time when operated under specified conditions, is a performance measure of a system. The objectives are: to develop a practical system effectiveness model which can handle various situations and include the important factors such as the environmental effect and operator effect; to introduce the model as a useful tool for consistent system evaluation and optimal test design; to approach availability and system effectiveness using renewal theory and develop a simulation approach to the solutions of performance whenever empirical data are given; to estimate availability by the Bayesian approach when the sample size is small; and to discuss the distribution functions of system performances such as reliability, availability, and the developed system effectiveness model. The rationale is that this is another step in the system effectiveness modeling and theoretical justification. Dissert. Abstr.

N81-11760# Los Alamos Scientific Lab., N. Mex.
PERFORMANCE EVOLUTION IN A LARGE SCALE SYSTEM
Richard Stell Brice and James Wayne Anderson 1980 22 p refs Presented at Computer Performance Evaluation Users Group Conf., Orlando, Fla., Oct. 1980
(Contract W-7405-eng-36)
(LA-UR-80-1185; CONF-801004-1) Avail: NTIS HC A02/MF A01

The evolution of system performance in an operating system from its initial use by a few users in October 1978 to its present state is documented. Some important features of the system, DEMOS, architecture are described. The robustness in the design is shown to permit major reduction in overhead with only minor software changes. Particular emphasis is placed on file system design and performance because much of the system overhead reduction occurred as a result of changes to this system component. Some predictions are made regarding performance resulting from proposed modifications. DOE

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N81-11761# South Carolina Univ., Columbia. Dept. of Mathematics and Statistics.
MARCINKOEWICZ-ZYGMUND WEAK LAWS OF LARGE NUMBERS FOR UNCONDITIONAL RANDOM ELEMENTS IN BANACH SPACES Interim Report
Joseph O. Howell and Robert L. Taylor Aug. 1980 21 p refs
(Contract F49620-79-C-0140)
(AD-A089928; TR-66; AFOSR-80-0957TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Convergence in probability is obtained for random elements in Banach spaces satisfying various distributional conditions including independence, conditional independence, unconditional semibasic, and weights. The constant p is related to a geometric property of the Banach space and to moment conditions. These results relax the usual hypothesis of identical distributions to tightness and are for conditionally independent and unconditionally semibasic random elements which are more general than independent random elements with zero means. E.D.K.

N81-11762# Brown Univ., Providence, R. I.
A DISCRETE APPROXIMATION FRAMEWORK FOR HEREDITARY SYSTEMS Interim Report
I. G. Rosen May 1980 105 p refs
(Contract DAAG29-79-C-0161; Grants AF-AFOSR-3092-76; NSF MCS-79-05774)
(AD-A089726; AFOSR-80-0941TR) Avail: NTIS HC A06/MF A01 CSCL 12/1

A discrete approximation framework for initial-value problems involving certain classes of linear functional differential equations (FDE) of the retarded type is constructed. An equivalence between the FDE and abstract evolution equations (AEE) in an appropriately chosen Hilbert space is established. This equivalence is then employed in the development of discrete approximation schemes in which the infinite-dimensional AEE is replaced by a finite-dimensional system of difference equations. Convergence and rates of convergence are demonstrated via the properties of rational functions with operator arguments and both classical and recent results from linear semigroup theory. Two examples of families of approximation schemes which are included in the general framework and which may be implemented directly on high-speed computing machines are developed. A numerical study of examples which illustrates the application and feasibility of the approximation techniques in a variety of problems together with a summary and analysis of the numerical results are also included. GRA

N81-11763# Naval Research Lab., Washington, D. C.
IDENTIFICATION OF FUZZY SETS WITH A CLASS OF CANONICALLY INDUCED RANDOM SETS AND SOME APPLICATIONS Final Report
Irwin R. Goodman 15 Sep. 1980 30 p refs
(XF12143310; RR0140241)
(AD-A089852; NRL-8415) Avail: NTIS HC A03/MF A01 CSCL 12/1

Any random subset of a space X clearly determines the membership function of a fuzzy subset through its one point coverages. This paper shows, conversely, that any fuzzy subset A of X can always be identified with, in general, many random subsets S(A) of X with respect to one point coverages. In a related manner, it is shown that any fuzzy set can be uniformly closely approximated with respect to one point coverages by a random set having a finite number of outcomes. Applications of the results to fuzzy attribute reasoning in both military and general contexts are presented, emphasizing the close connection between fuzzy and random confidence sets. Extensions of the above results to non-canonical mappings and multiple point coverage functions are also treated. GRA

N81-11764# Los Alamos Scientific Lab., N. Mex. Computer Sciences and Services Div.
IMPLEMENTING TECHNIQUES FOR ELLIPTIC PROBLEMS ON VECTOR PROCESSORS
B. L. Buzbee 1980 15 p refs Presented at the Proc. of the Elliptic Probl. Solvers Conf., Santa Fe, N. Mex., 30 Jun. - 2 Jul. 1980 Submitted for publication
(Contract W-7405-eng-36)
(LA-UR-80-2343; CONF-800699-3) Avail: NTIS HC A02/MF A01

To provide the arithmetic power required by large scale numerical simulations, the fastest computers today incorporate vector processing. Two types of vector architecture are defined, and the variation in performance that can occur on a vector processor as a function of algorithm and the performance of some basic operators on the two classes of vector architecture

are discussed. The performance of some higher level operators that should be used with caution is also considered. Then the implementation of techniques for elliptic problems using the operators discussed previously is reviewed. Included are fast Poisson solvers, dissection, and point, line, block, and conjugant gradient schemes. DOE

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N81-11765# Electronics Research Lab., Adelaide (Australia).
THE TRIBO-ELECTRIC EFFECT OF LIQUID FLOW AND ITS APPLICATIONS
I. K. Varga Jul. 1980 18 p refs
(AD-A089923; ERL-0137-TR; AR-001-987) Avail: NTIS HC A02/MF A01 CSCL 20/3

The flow of liquids through dielectric tubes is shown to produce a frictional electromotive force, and an empirical relation is established between the voltage generated and the various experimental factors controlling it. The application of the effect to the measurement of the flow rate and the electrical resistivity of fluids is discussed. GRA

N81-11766# Los Alamos Scientific Lab., N. Mex.
PROCEEDINGS OF THE WORKSHOP ON PROGRAM OPTIONS IN INTERMEDIATE ENERGY PHYSICS. KEYNOTE ADDRESS: NEW DIRECTIONS IN INTERMEDIATE-ENERGY NUCLEAR PHYSICS
Gerry E. Brown May 1980 19 p Conf. held at Los Alamos Scientific Lab., N.M., 20-31 Aug. 1979
(Contract W-7405-eng-36)
(LA-8335-C-Vol-2; CONF-7908121-1(Vol-2)) Avail: NTIS HC A02/MF A01

The keynote address given on August 21, 1979, for the Workshop on Program Options in Intermediate Energy Physics is presented. Major topics of interest in intermediate energy nuclear physics and suggested experimental approaches that might be most productive in the near future were reviewed. DOE

N81-11767# Sandia Labs., Albuquerque, N. Mex.
PULSED MAGNETIC FIELD DISTRIBUTION NEAR CONDUCTING RINGS
E. L. Patterson and J. R. Freeman Jul. 1980 26 p refs
(Contract DE-AC04-76DP-00789)
(SAND-80-1546) Avail: NTIS HC A03/MF A01

Measurements and calculations of the magnetic field distribution in the vicinity of stainless steel rings immersed in a pulsed magnetic field are compared. The perturbations in magnetic field due to the rings are considerably less than expected from one dimensional skin depth considerations. DOE

N81-11768# California Univ., Livermore. Lawrence Livermore Lab.
STATISTICAL METHODS FOR INCLUDING TWO-BODY FORCES IN LARGE SYSTEM CALCULATIONS
Stevens M. Grimes Jul. 1980 14 p refs
(Contract W-7405-eng-48)
(UCID-18740) Avail: NTIS HC A02/MF A01

Large systems of interacting particles are often treated by assuming that the effect on any one particle of the remaining N-1 may be approximated by an average potential. This approach reduced the problem to that of finding the bound state solutions for a particle in a potential; statistical mechanics is then used to obtain the properties of the many body system. In some physical systems, this approach may be acceptable, because the two body force component cannot be treated in this one body limit. A technique for incorporating two body forces in such calculations in a more realistic fashion is described. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N81-11769*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. Fluid Mechanics and Acoustics Div.
CORE NOISE MEASUREMENTS FROM A SMALL, GENERAL AVIATION TURBOFAN ENGINE
Meyer Reshotko and Allen Karchmer 21 Nov. 1980 28 p refs Presented at the 100th Meeting of the Acoust. Soc. of Am., Los Angeles, 17-21 Nov. 1980
(NASA-TM-81610; E-607) Avail: NTIS HC A03/MF A01 CSCL 20A

As part of a program to investigate combustor and other core noises, simultaneous measurements of internal fluctuating pressure and far field noise were made with a JT15D turbofan engine. Acoustic waveguide probes, located in the engine at the combustor, at the turbine exit and in the core nozzle wall, were used to measure internal fluctuating pressures. Low frequency acoustic power determined at the core nozzle exit corresponds in level to the far field acoustic power at engine speeds below 65% of maximum, the approach condition. At engine speeds above 65% of maximum, the jet noise dominates in the far field, greatly exceeding that of the core. From coherence measurements, it is shown that the combustor is the dominant source of the low frequency core noise. The results obtained from the JT15D engine were compared with those obtained previously from a YF102 engine, both engines having reverse flow annular combustors and being in the same size class.
Author

N81-11770*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF A SEMI-ANNULAR THERMAL ACOUSTIC SHIELD ON JET EXHAUST NOISE
J. Goodykoontz 21 Nov. 1980 21 p refs Presented at the 100th Meeting of the Acoust. Soc. of Am., Los Angeles, 17-21 Nov. 1980
(NASA-TM-81615; E-616) Avail: NTIS HC A02/MF A01 CSCL 20A

Reductions in jet exhaust noise obtained by the use of an annular thermal acoustic shield consisting of a high temperature, low velocity gas stream surrounding a high velocity central jet exhaust appear to be limited by multiple reflections. The effect of a semi-annular shield on jet exhaust noise was investigted with the rationale that such a configuration would eliminate or reduce the multiple reflection mechanism. Noise measurements for a 10 cm conical nozzle with a semi-annular acoustic shield are presented in terms of lossless free field data at various angular locations with respect to the nozzle. Measurements were made on both the shielded and unshielded sides of the nozzle. The results are presented parametrically, showing the effects of various shield and central system velocities and temperatures. Selected results are scaled up to a typical full scale engine size to determine the perceived noise level reductions. A.R.H.

N81-11771# Delaware Univ., Newark. Applied Mathematics Inst.
REMARKS ON THE INVERSE SCATTERING PROBLEM FOR LOW FREQUENCY ACOUSTIC WAVES Interim Report
David Colton 15 May 1980 17 p refs
(Grants AF-AFOSR-2879-76; NSF MCS-78-02452; AF Proj. 2304)
(AD-A089875; TR-70A; AFOSR-80-0639TR) Avail: NTIS HC A02/MF A01 CSCL 20/1

In a recent series of papers (2, 3, 4) the author has investigated the low frequency inverse scattering problem for 'hard' and 'soft' infinite cylinders and 'soft' obstacles in space. It is the purpose of this paper to complete the story and consider the inverse scattering problem in space where the obstacle is 'hard', i.e. the boundary condition is of Neumann type. A basic result of the analysis to date is that the low frequency inverse scattering problem can be stabilized. In the case of domains in the plane this is accomplished by transmitting two plane waves from

different directions, where the second plane wave is used to determine the transfinite diameter of the obstacle. GRA

N81-11772# Materials Research Labs., Maribyrnong (Australia).
INTERMEDIATE FREQUENCY SOUND ABSORPTION IN SEAWATER: THE ROLE OF MAGNESIUM SULFATE
Daniel J. Whelan Jun. 1980 20 p refs
(AD-A090269; MRL-R-777; AR-002-162) Avail: NTIS HC A02/MF A01 CSCL 20/1

The resonant absorption frequency, and the excess absorption parameter for 0.014 m MgSO4 in water a 4 C and 100 atmosphere pressure have been calculated and agree quite closely with those values defined by the Thorp equation for deep ocean sound channel absorption at intermediate frequencies. GRA

N81-11773# Naval Underwater Systems Center, Newport, R. I. Special Projects Dept.
DOPPLER SPECTRA OF BISTATIC REVERBERATION FROM THE SEA SURFACE Ph.D. Thesis
William I. Roderick 8 May 1979 259 p refs
(NUSC Proj. A-650-04)
(AD-A090042; NUSC-TR-6031) Avail: NTIS HC A12/MF A01 CSCL 20/1

The Doppler spectra of sea surface reverberation were investigated in a shallow water environment. A parametric array projected a narrow beam of acoustic energy at the surface and insonified on the surface a well-defined scattering area of limited extent. The surface generated reverberation was received on eight closely spaced hydrophones of a vertical array. The power spectral densities of the instantaneous reverberation, the Doppler spectra, were of primary interest in the analyses of the reverberation data. Doppler spectra were measured as a function of the transmitted parametric difference frequency, the angle of incidence of the array to the sea surface, and the angle of scatter of the reverberation to the receiving hydrophones. In concert with the reverberation experiment, the directional spectrum of the sea surface waves was measured with an acoustic wave height sensing system. A line array of acoustic wave height sensors simultaneously measured the time varying wave height at five discrete points on the sea surface. It is concluded that the surface reverberation Doppler spectra and the sea surface directional spectrum represent a unique data collection that can be used for theoretical reverberation model development and subsequent model verification. Furthermore, the Doppler spectra are applicable to the system design and performance prediction of surface reverberation-limited sonar systems operating in low sea states and at similar sonar frequencies. GRA

N81-11774# State Univ. of New York at Buffalo, Amherst. Faculty of Engineering and Applied Sciences.
COOPERATIVE INVESTIGATION OF THE NOISE PRODUCING REGION OF AN AXISYMMETRIC JET Final Report
W. K. George, R. E. A. Arndt, and H. M. Nagib Jul. 1980 34 p refs
(Contract F49620-78-C-0047)
(AD-A089692; AFOSR-80-0754TR) Avail: NTIS HC A03/MF A01

The objectives of this three-university effort are: to determine whether or not large scale structures exist in the mixing layer of an axisymmetric jet; to determine whether or not these large scale structures (if they exist) contribute to the radiated noise; and to quantify the above conclusions so that the results can be used for evaluation of jet noise theories and for prediction of radiated noise. This is a report on the initial phase of the work in which the primary emphasis has been on the construction of the experimental facilities, the acquisition and assembly of the measurement hardware and the development of computer software. Noteworthy advances include an analysis and extension of the burst-mode LDA, and the continued development of digitally sampled flow visualization techniques. Experiments on various nozzle shapes at low Reynolds number indicate that nozzle shape plays an important role in determining the vortex pairing in the mixing layer and the radiated noise. This does not appear to be the case at high Reynolds numbers. The preliminary conclusion is that the pairing and turbulence structures observed at low Reynolds numbers have little to do with jet noise. GRA

N81-11775# Delaware Univ., Newark. Applied Mathematics Inst.
ITERATIVE METHODS FOR SOLVING THE EXTERIOR DIRICHLET PROBLEM FOR THE HELMHOLTZ EQUATION WITH APPLICATIONS TO THE INVERSE SCATTERING PROBLEM FOR LOW FREQUENCY ACOUSTIC WAVES
David Colton and Rainer Kress May 1980 21 p refs Prepared in cooperation with Goettingen Univ., West Germany
(Grants AF-AFOSR-2879-76; NSF MCS-78-02452; AF Proj. 2304)
(AD-A089873; TR-72A; AFOSR-80-0637TR) Avail: NTIS HC A02/MF A01 CSCL 20/1

A previous paper presented an iterative method for solving the exterior Dirichlet problem for the Helmholtz equation defined in the plane and used this result to provide a constructive approach for solving the low frequency inverse scattering problem for a cylinder. These results were based on the use of conformal mapping and the fact that the integral of the normal derivative of the total field over the boundary of the obstacle vanishes, neither of which is valid in the three dimensional case. The present paper shows how the previous analysis can be modified in order to extend these results to the case of the exterior Dirichlet problem for the Helmholtz equation in R3. Our results are based on choosing an appropriate fundamental solution such that the integral equation associated with the exterior Dirichlet problem can be solved by iteration for sufficiently small values of the wave number. GRA

N81-11776# Tennessee Univ., Knoxville. Space Inst.
AN INVESTIGATION OF THE SOUND GENERATED BY AN AXISYMMETRIC JET INTERACTING WITH A DIFFUSER Final Report, 15 Nov. 1979 - 15 Jan. 1980
J. R. Maus and C. V. Sundaram Sep. 1980 184 p refs
(Contract F40600-77-C-0009)
(AD-A090125; AEDC-TR-80-15) Avail: NTIS HC A09/MF A01 CSCL 20/4

A study of the sound generated by the interaction of an axisymmetric exhaust jet with a constant area circular diffuser has been carried out. The results of the investigation show that the acoustic field produced by the jet/diffuser interaction is quite different from that generated by the jet alone. The variation of overall sound power with changes in the geometric and fluid dynamic parameters indicates a complex interplay between the sound sources, shielding, and acoustic feedback. For certain test configurations, intense discrete frequency tones occur that are, in many cases, 20 dB or more above the broad-band noise. The test results indicate that the smallest ratio of diffuser diameter to nozzle diameter tested (D sub d/D sub n – 1.43) with the diffuser entrance located less than 0.5 nozzle diameters from the nozzle produced the lowest sound power for all velocities tested. Tests with two different-sized nozzles (scale factor = 2) indicate that standard acoustic scaling laws are adequate to extrapolate the results to full-scale conditions. GRA

N81-11777# Naval Postgraduate School, Monterey, Calif.
ECTRACE: THREE DIMENSIONAL ACOUSTIC RAY TRACE PROGRAM M.S. Thesis
Robert Neal Christianson and Luis Ricardo Erazo Mar. 1980 210 p refs
(AD-A089931) Avail: NTIS HC A10/MF A01 CSCL 20/1

Acoustic ray paths in the ocean are known to exhibit significant horizontal deflections after repeated reflections from the bottom. The effect may be quantitatively and qualitatively observed through a ray trace model which permits a change in direction of the vertical plane of propagation as a function of bottom slope and grazing angle. ECTRACE is a family of computer programs which traces a bundle of rays in three dimensions and utilizes bottom depth values as a portion of its input. Included are related programs which develop sea bed models from digitized bathymetry data or synthetic bathymetry functions. GRA

N81-11778# Rockwell International Corp., El Segundo, Calif. North American Aircraft Div.
WEAPON BAY CAVITY NOISE ENVIRONMENTS, DATA CORRELATION AND PREDICTION FOR THE B-1 AIRCRAFT Final Report, Feb. 1979 - May 1980
A. G. Tipton Wright-Patterson AFB, Ohio AFFDL Jun. 1980 239 p refs

(Contract F33615-79-C-3208; AF Proj. 2401)
(AD-A089770; NA-80-247; AFWAL-TR-80-3050) Avail: NTIS HC A11/MF A01 CSCL 20/1

During development of the B-1 aircraft, an extensive cavity noise measurement and noise reduction program using wind tunnel models and evaluation on a flight-test aircraft was conducted. Substantial cavity noise reduction was achieved with retrofitted spoilers for a Mach 0.6 to 1 range for the weapon bay cavity of L/D = 2.2. A substantial amount of cavity unsuppressed and suppressed data were acquired from wind tunnel models and the full-scale aircraft. Data for weapon bay cavities with internal stores and multiple open cavities was also obtained. The data acquired during development of B-1 cavity noise suppressors are correlated and compared with previously published data. The data are correlated with existing prediction techniques and modifications to the current prediction techniques, and guidelines are recommended. GRA

N81-11779# California Univ., Livermore.
ANALYSIS OF MICROCRACKS IN DRY POLYCRYSTALLINE NaCl BY ULTRASONIC SIGNAL PROCESSING Ph.D. Thesis
Frederick M. Sears 1980 369 p refs Sponsored in part by the National Fellowships Fund, Atlanta
(Contract W-7405-eng-48)
(UCRL-52975) Avail: NTIS HC A16/MF A01

Existing anelastic theories on the Q determination problem are compared with experimental measurements to better understand rock properties. Ultrasonic pulse methods were utilized to examine crack geometries as a function of frequency and thermal cycling temperature in dry polycrystalline rock salt. The attenuation of compressional (P) and shear (S) waves was studied in a thermally induced isotropic distribution of microcracks using ultrasonic transmission techniques. These attenuation measurements led to the following series of generalities: ultrasonic or seismic attenuation depends on frequency in the rocks tested; thermal cycling of rock salt increases the porosity and attenuation; grain scattering seems to be the dominant loss mechanism at the higher frequencies in rocks; friction explains why the introduction of cracks into rock salt increases the attenuation; and attenuation appears to be independent of strain amplitude for low strains such as those associated with these measurements. DOE

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N81-11780# Epsilon Labs., Bedford, Mass.
A MOLECULAR IDENTIFICATION DEVICE FOR INDIVIDUAL SUBMICRON AEROSOLS: FEASIBILITY STUDY Final Report, Aug. 1978 - Dec. 1979
Henry A. Miranda, Jr. May 1980 36 p refs
(Contract F19628-78-C-0168)
(AD-A090018; AFGL-TR-80-0155) Avail: NTIS HC A03/MF A01 CSCL 13/7

An experimental feasibility study to demonstrate the viability of a concept for determining the molecular constituency of stratospheric submicron particulates on an individual particle basis, is described. Recommendations for continuing the program as far as the demonstration milestone are presented. Included among these are: (1) a means of greatly simplifying the test apparatus set-up (thereby reducing the probability of interruption by critical component failure), and (2) specific investigations to develop engineering data for the design of a future field prototype device. GRA

N81-11781# Houston Univ., Tex. Dept. of Chemistry.
INTERACTIONS OF MOLECULAR ION BEAMS WITH SURFACES Final Report, 1 Jul. 1979 - 30 Jun. 1980
J. Wayne Rabalais 8 Sep. 1980 10 p refs
(Contract DAAG29-79-C-0136)
(AD-A089959; Rept-1) Avail: NTIS HC A02/MF A01 CSCL 20/7

Reactions of positive N(-2) ion beams with the surface of polycrystalline rhenium foil over the range 150-3000 eV have been studied by the techniques of X-ray photoelectron spectroscopy (XPS) and thermal desorption spectrometry (TDS). The reactions produce a nitride layer of the type ReNx, 0.21 less than or equal to X less than or equal to 0.40, with X varying as a function of ion kinetic energy and depth into the surface. The nitride layer extends from the surface down to the penetration depth of the atoms, which varies from approx. 15 angstroms at 0.3 keV to approx. 76 angstoms at 2.5 keV ion energy. The product nitride and chemisorbed nitrogen on Re are distinctly different, exhibiting N1s binding energies of 397.9 and 396.8 eV, respectively, and TDS maxima near 425 and 600 C, respectively. GRA

N81-11782# Arizona Univ., Tucson. Dept. of Physics.
TIME-OFFLIGHT SPECTROSCOPY OF MOLECULAR STRUCTURE, COLLISION PROCESSES, AND GAS SURFACE INTERACTIONS Final Technical Report, 15 Jun. 1975 - 14 Jun. 1980
Willis E. Lamb, Jr. and Laurence C. McIntyre, Jr. 29 Jul. 1980 11 p refs
(Grant AF-AFOSR-2864-75; AF Proj. 2301)
(AD-A089897; AFOSR-TR-80-0746TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

Progress in molecular physics research using time-of-flight techniques to measure velocity distributions of fragments from dissociating molecules is reported. Electron bombardment at energies between 20 and 100 eV was used to dissociate the molecules, and only fragments with kinetic energies greater than about 1 eV were detected. Both metastable hydrogen atoms and one-, two-, and three-atom hydrogenic charged fragments were detected. Special selective detectors were designed and built for metastable hydrogen atoms as well as a mass filter for identifying the mass of ionic fragments. A large portion of this work was done using the hydrogen molecule and its deuterated forms; however, heavier molecules such as methane, ethane, methanol, and ethanol, were also studied. GRA

N81-11783# Science Applications, Inc., Vienna, Va.
SOFT X-RAY PHOTOEMISSION: DEVELOPMENT OF USER ORIENTED CODE SXRP AND ITS APPLICATION TO PHOTOEMISSION, ELECTRON BACKSCATTER, CHARGE DEPOSITION AND ENERGY DEPOSITION Final Report, 1 Nov. 1978 - 1 Nov. 1979
D. J. Strickland and D. L. Lin 1 Mar. 1980 65 p refs
(Contract DNA001-79-C-0084)
(AD-A089714; SAI-102-80-001; DNA-5307F) Avail: NTIS HC A04/MF A01 CSCL 07/4

This work is a continuation of our program to characterize soft X-ray photoemission for various materials used in space systems. The code SXRP is developed specifically to achieve this goal. Results predicted by this code for X-ray line sources are compared with measurements in this report. General agreement is found between theory and experiments. To assist SGEMP analysts in modeling the electromagnetic environment of systems exposed to soft X-ray in simulation test, a user-oriented algorithm for choosing transport energy grid is successfully developed for code SXRP. Electron backscatter of Al and Au are investigated to further test the scattering model in code SXRP. Another investigation concerned charge and energy deposition in Teflon for incident soft electron sources. Both investigations demonstrate the capability of SXRP to treat external electron as well as X-ray sources. GRA

N81-11784# Michigan State Univ., East Lansing. Dept. of Chemistry.
SELECTED ION FRAGMENTATION WITH A TRIPLE QUADRUPOLE MASS SPECTROMETER Ph.D. Thesis Interim Report
Richard Alan Yost and Christie G. Enke 19 Sep. 1980 110 p refs
(Contract N00014-76-C-1092; NR Proj. 051-634)
(AD-A089824; TR-5) Avail: NTIS HC A06/MF A01 CSCL 07/4

A triple quadrupole mass spectrometer (TOMS) has been designed and developed for the direct analysis of mixtures and the elucidation of molecular structures. In the TOMS, several

ionic species are generated from a sample, ions of a particular mass are selected for fragmentation, and the resulting fragment ions are mass analyzed. The instrument consists of, in series, a dual chemical ionization/electron impact (CI/EI) ionization source, a quadrupole mass filter, an RF-Only quadrupole that can be pressurized with a collision gas, a second quadrupole mass filter, and an electron multiplier. The ion fragmentation process is performed by collision-induced dissociation (CID) in the RF-only quadrupole collision chamber. The instrument is described and its performance evaluated. For structure elucidation, the formation and fragmentation of every fragment ion from a compound can be directly determined. For mixture analysis, the first mass analyzer can separate the mixture components as their molecular ions, produced by soft ionization (e.g., CI) of the sample. The fragmentation spectra of the individual components can then be obtained by fragmenting the selected molecular ions and scanning the second analyzer. The identification of isomeric and isobaric compounds in a mixture is demonstrated. Detection limits of ten to the minus 15th power mole for methane and nitrobenzene are shown. GRA

N81-11785# Illinois Univ., Urbana. Dept. of Chemistry.
LIGHT-INDUCED ELECTRON TRANSFER VS. ENERGY TRANSFER IN MOLECULAR THIN-FILM SYSTEMS
Clifford L. Renschler and Larry R. Faulkner 1980 24 p refs Presented at the Photoelectrochem. Conf., Oxford, 8-10 Sep. 1980
(Contract DE-AC02-76ER-01198)
(DOE/ER-01198/1306; CONF-800905-1) Avail: NTIS HC A02/MF A01

Quenching of fluoranthene (FA) singlets by tetrabromo-obenzoquinone (TBBQ) and N,N,N,'N'-tetramethyl-p-phenylenediamine (TMPD) was studied both in xylene solutions and in spin-cast polystyrene (PS) films. Emphasis was placed on time resolved fluorescence transients resulting from pulsed excitation. Linear Stern Volmer plots were obtained for quenching in solution and gave diffusion controlled rate constants. TBBQ was found to quench FA singlets in PS over the studied concentration range 12 mM < (TBBQ) < 48 mM, but in its presence FA singlets decayed nonexponentially. The results were interpreted quantitatively in terms of pure Foerster's transfer from FA to TBBQ without diffusion of excitons. DOE

N81-11786# Ohio State Univ., Columbus. Dept. of Chemistry.
KINETICS OF GROWTH AND DECAY OF EXCITED RARE GAS ATOMS AND MOLECULES IN THE PULSE RADIOLYSIS OF PURE RARE GASES AND OF MIXTURES OF RARE GASES WITH MOLECULAR QUENCHING AGENTS Technical Progress Report
Richard F. Firestone 15 Aug. 1980 21 p refs
(Contract DE-AS02-76ER-01116)
(DOE/ER-01116/33) Avail: NTIS HC A02/MF A01

A study of effects of H2, O2 and N2 on the decay rates of all of the Ar(1s) species in argon in the 100 to 1000 torr region is presented. The excited atoms were formed by a pulsed relativistic electron beam. Quenching was found to occur via a direct bimolecular interaction and by means of a two step sequence in which the first step is two body formation of a dissociative vibrationally excited excimer molecular and the second step is vibrational relaxation of this species by the molecular quenching agent. The decreasing order of bimolecular quenching efficiency is O2, H2, N2 for all Ar(1s) species and that of decreasing potential energy among the Ar(1s) species for each of the quenching agents. DOE

N81-11787# Brookhaven National Lab., Upton, N. Y.
LOW P sub T INCLUSIVE PRODUCTION IN HADRONNUCLEUS COLLISIONS
D. S. Barton 1980 15 p refs Presented at 11th Intern. Symp. on Multiparticle Dynamics, Bruges, Belgium, 22-27 Jun. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28166; CONF-8006108-1) Avail: NTIS HC A02/MF A01

Experimental results on the A dependence of inclusive hadron scattering are described with emphasis on the projectile fragmentation region. The experimental apparatus consisted of the Fermilab M6E beam line and the Single Arm Spectrometer Facility. An incident beam of 100 GeV/c was used; the production of fast h' was measured over the transverse momentum range from 0.18 to 0.5. Invariant cross sections are presented and fitted to a power law function in A. For all channels, increasing attenuation as a function of A is seen. Fitted values of fragmentation functions of spectator and wounded quarks are shown for pion induced reactions. DOE

N81-11788# Ames Lab., Iowa. Dept. of Chemistry.
ADSORPTION OF ORGANIC MOLECULES AT THE MERCURY-SOLUTION INTERFACE: EFFECT OF ANION SPECIFIC ADSORPTION ON DOUBLE LAYER PROPERTIES Ph.D. Thesis
John Joseph Buckfelder, 3rd Aug. 1980 122 p refs
(Contract W-7405-eng-82)
(IS-T-888) Avail: NTIS HC A06/MF A01

Adsorption of iso-pentanol, pentanoic acid, and benzyl alcohol at the mercury solution interface was studied in HC104, H3SO4, NaNO3, and NaF electrolytes. Linear charge vs surface excess plots were obtained for the aliphatic compounds over the entire potential region studied; for benzyl alcohol, plots were linear only at anodic potentials. At potentials anodic to the electrocapillary maximum, deviations between experimental and theoretical slopes appeared. In the model proposed, the double layer consists of two parts. The layer closest to the surface was restricted to water molecules and specifically adsorbed ions. The second layer contained organic molecules exclusively; any charge necessary to balance the surface charge was considered to be in a monolayer adjacent to the organic layer. DOE

N81-11789# Oak Ridge National Lab., Tenn.
ASPECTS OF THE PHYSICS, CHEMISTRY, AND TECHNOLOGY OF HIGH INTENSITY HEAVY ION SOURCES
G. D. Alton 1980 80 p refs Presented at the 3rd Intern. Conf. on Ion Implantation: Equipment and Tech., Kingston, Ontario, 8-11 Jul. 1980
(Contract W-7405-eng-26)
(CONF-800738-1) Avail: NTIS HC A05/MF A01

Particular emphasis is placed on the technology of plasma discharge ion sources which utilize solid elemental or molecular compounds to produce vapor for the ionization process. The elementary concepts underlying the formation and extraction of ion beams from plasma discharge sources are discussed and low charge state positive ion sources suitable for accelerator use are reviewed. DOE

N81-11790# Princeton Univ., N. J. Plasma Physics Lab.
INFLUENCE OF STOCHASTIC MAGNETIC FIELDS ON THE CONFINEMENT OF RUNAWAY ELECTRONS AND THERMAL ELECTRON ENERGY IN TOKAMAKS
H. E. Mynick and J. D. Strachan Jul. 1980 33 p refs
(Contract DE-AM02-76CH-03073)
(PPPL-1680) Avail: NTIS HC A03/MF A01

The ratio of the runaway electron confinement to thermal electron energy confinement was derived for Tokamaks where both processes were determined by free streaming along stochastic magnetic field lines. The runaway electron confinement was enhanced at high runaway electron energies due to phase averaging over the magnetic perturbation when the runaway electron drift surfaces were dislaced from the magnetic surfaces. Data from LT-3, ORMAK, PLT, ST, and TM-3 were compared. It is shown that magnetic stochasticity may explain the relative transport rates of runaways and thermal electron energy. DOE

N81-11791# Los Alamos Scientific Lab., N. Mex.
INJECTION SYSTEM FOR THE PROTON STORAGE RING AT LASL Final Report
Daniel W. Hudgings and Andrew J. Jason 1980 6 p refs Presented at 11th Intern. Conf. on High Energy Accelerators, Geneva, 7 Jul. 1980
(Contract W-7405-eng-36)
(LA-UR-80-1945; CONF-800740-7) Avail: NTIS HC A02/MF A01

The proton storage ring at LAMPF will accumulate a high current of 800 MeV protons by multiturn charge-changing injection. An 800 MeV neutral hydrogen atomic beam, formed

by field ionization of H ions in a 1.8 T transverse magnetic field, will be stripped to proton by a carbon foil. To minimize peak proton current on the foil, the beam orbit will be deformed so that the edge of the beam grazes the edge of the foil. As the beam diameter grows, the orbit perturbation is decreased, vanishing at the end of the accumulation cycle. The hardware requirements are simple. Single-turn orbit deformation magnets are pulsed to peak field and switched across power dissipation circuits that control the field decay rate. Stripping foil requirements and a method of calculating the desired orbit deformation are described. DOE

N81-11792# Los Alamos Scientific Lab., N. Mex.
POLARIZATION TRANSFER IN INELASTIC SCATTERING
Joel M. Moss 1980 10 p refs Presented at 5th Intern. Symp. on Polarization Phenomena in Nucl. Phys., Santa Fe, N.Mex., Aug. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2427; CONF-800824-20) Avail: NTIS HC A02/MF A01

Polarization transfer experiments are feasible for inelastic scattering experiments on complex nuclei. The spin flip probability is sensitive to the action of spin-spin and tensor forces in inelastic scattering. Spin flip probabilities at E approximately 40 MeV in isoscalar transitions in 12C(12.71 MeV) and 15O(8.89 MeV) showed a considerable deviation from DWBA shell model predictions; this deviation indicates evidence for more complex reaction mechanisms. Experiments at intermediate energies will be possible and will yield data of much higher precision than is possible at lower energies. These experiments hold promise in such areas as nuclear critical opalescence. DOE

N81-11793# Los Alamos Scientific Lab., N. Mex.
DIFFERENTIAL CROSS SECTIONS FOR p PLUS He-3 SCATTERING FROM 19.5 TO 47.5 MeV
Ronald E. Brown, B. T. Murdoch, D. K. Hasell, A. M. Sourkes, and W. T. H. vanOers Jul. 1980 16 p refs
(Contract W-7405-eng-36)
(LA-8179-MS) Avail: NTIS HC A02/MF A01

Differential cross sections for He(p,p)3He elastic scattering was measured at 11 energies from 19.5 to 47.5 MeV. The most forward center of mass angle for the angular distributions varied from 10.1 to 13.4 deg and the most backward angle varied from 163.2 to 173.4 deg. The relative errors are usually less than 2%, and the scale error is 1.5%. DOE

N81-11794# Los Alamos Scientific Lab., N. Mex.
MONOCHROMATIC NEUTRAL KAON BEAM
Cyrus M. Hoffman Jul. 1980 8 p refs
(Contract W-7405-eng-36)
(LA-8444-MS) Avail: NTIS HC A02/MF A01

A design for a monochromatic, neutral kaon beam, is described. Possible uses of such a beam are discussed. DOE

N81-11795# Stanford Linear Accelerator Center, Calif.
RATIO D(0) AND D(+) LIFETIMES FROM THEIR SEMILEPTONIC DECAYS
G. J. Donaldson Jun. 1980 32 p refs Presented at Orbis Scientiae, Coral Gables, Fla., 14-17 Jan. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-Pub-2532; CONF-800123-4) Avail: NTIS HC A03/MF A01

The conventional expectation for the decays of D mesons assumes that the charm quark decays in the presence of light, spectator quarks and thus the lifetimes of both charged and uncharged states are equal. Evidence is presented from DELCO (at SPEAR) that the D lifetimes are quite different for neutral and charged mesons, and the results available from other experiments are reviewed. DOE

N81-11796# Stanford Linear Accelerator Center, Calif.
RECENT EXPERIMENTAL RESULTS ON THE BEAM EFFECTS IN STORAGE RINGS AND AN ATTEMPT OF THEIR INTERPRETATION
S. Kheifets Jun. 1980 30 p refs Presented at 11th Intern. Conf. on High Energy Accelerators, Geneva, 7-11 Jul. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-Pub-2548; PEP-Note-333; CONF-800740-13) Avail: NTIS HC A03/MF A01

The experimental results on the luminosity, the space charge parameters, and the beam blowup as functions of particle energy and beam current were reviewed. The comparison with the phenomenological diffusion theory was done and useful scaling laws were derived. Some implications for anti p p storage rings are discussed. DOE

N81-11797# Stanford Linear Accelerator Center, Calif.
RADIATIVE TRANSITIONS FROM THE psi (3095) TO ORDINARY HADRONS
D. L. Scharre May 1980 25 p refs Presented at 6th Intern. Conf. on Exptl. Meson Spectry., Upton, N.Y., 25-26 Apr. 1980
(Contract DE-AC03-79SF-00515)
(SLAC-Pub-2519; CONF-8004102-2) Avail: NTIS HC A02/MF A01

Preliminary results from the Mark II and Crystal Ball experiments on radiative transitions from the psi to ordinary hadrons are presented. In addition to the previously observed transitions to the eta, eta'(958), and f(1270), both groups observe a transition to a state which is tentatively identified as the E(1420). DOE

N81-11798# Naval Research Lab., Washington, D. C. Plasma Technology Branch.
ION BEAM PROPAGATION IN A FILAMENTED CHANNEL Interim Report
P. F. Ottinger (JAYCOR, Alexandria, Va.), S. A. Goldstein (JAYCOR, Alexandria, Va.), and D. Moster 3 Mar. 1980 13 p refs
(Contract DE-AI01-77DP-40042)
(NRL-MR-4180) Avail: NTIS HC A02/MF A01

The production of intense focused ion beams led to the consideration of using z-discharge plasma channels to transport them several meters to inertial fusion targets. Current bunching will occur in the channel during transport. Ion beam propagation in a filamented channel was investigated in order to determine the effects on radial beam containment in channels and on the radial beam density profile. DOE

N81-11799# Battelle Pacific Northwest Labs., Richland, Wash.
SECONDARY ELECTRON EMISSION IN ION-ATOM COLLISIONS
L. H. Toburen and W. E. Wilson Aug. 1980 10 p refs Presented at 24th Intern. Meeting of the Inst. of Management Sci., Honolulu, Hawaii, 15 Jun. 1979
(PNL-SA-7417; CONF-7906181-1) Avail: NTIS HC A02/MF A01

A clear need for knowledge of the energy concentrations randomly deposited in very small volumes in and near the paths of charged particles exists. Because direct measurement of energy deposition in small sites is not technically feasible, it is necessary to develop mathematical models capable of calculating the desired quantities. Realistic computational methods, however, require a comprehensive data base of basic interaction cross sections. This data base must include interaction probabilities for the primary and all secondary radiation products. Of particular interest are the cross sections for the production of secondary electrons in primary ionizing events. The extent to which this data base has developed regarding the interaction of fast charged particles with media of biological interest was examined. DOE

N81-11800# California Univ., Davis. Dept. of Physics.
TWO-PHOTON COLLISIONS AND QCD
J. F. Gunion May 1980 25 p refs Presented at Intern. Workshop on Gamma-Gamma Collisions, Amiens, France, 8 Apr. 1980
(Contract DE-AC03-76SF-00515)
(SLAC-PUB-2503; CONF-800499-2) Avail: NTIS HC A02/MF A01

A critical review of the applications of quantum chromodynamic (QCD) to low and high-p sub T/interactions of two photons is presented. The advantages of the two-photon high-p/sub T/tests over corresponding hadronic beam and/or target tests of QCD are given particular emphasis. DOE

N81-11801# Missouri Univ. -St. Louis. Atomic and Molecular Physics Lab.

OBSERVATION OF LUMINESCENT SPECTRA IN LOW ENERGY ION-NEUTRAL COLLISIONS Progress Report, 1 Jun. 1979 - 31 May 1980
J. J. Leventhal 1980 15 p refs
(Contract DE-AS02-76ER-02718)
(COO-2718-8) Avail: NTIS HC A02/MF A01

An apparatus was constructed for the purpose of studying laser assisted charge transfer. A method of measuring metal atom densities in the vapor phase is discussed. Modelling of energy transfer in molecular systems is included. DOE

N81-11802# Rensselaer Polytechnic Inst., Troy, N. Y.
ION BEAM PROBE DIAGNOSTIC SYSTEM Technical Progress Report, 1 Jan. 1979 - 30 Jun. 1980
R. L. Hickok, W. C. Jennings, J. T. Woo, and K. A. Connor Jul. 1980 30 p refs
(Contract DE-AS02-76ET-53004)
(DOE/ET-53004/1; RPDL-80-17) Avail: NTIS HC A03/MF A01

Tokomak plasmas suitable for diagnostic development were produced in RENTOR following technological improvements in the vacuum chamber and discharge cleaning systems. Secondary ion signals were obtained from the heavy ion beam probe on RENTOR leading to initial estimates of the plasma space potential, which appears to vary by several hundred volts during the plasma pulse. The principle of measuring space potential in a minimum-B geometry was established using an ion gun mounted at the center of the ALEX baseball coil. The neutral beam probe was installed for measuring the space potential using actual secondary ion signals from a hollow cathode arc in ALEX and preliminary tests have begun. The ion beam test stand was significantly altered to allow more flexibility in testing energy analyzers, ion guns, and ion focusing concepts. DOE

N81-11803# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
INFLUENCE OF PROPAGATION ON OFF-RESONANT MOLECULAR EXCITATION
J. H. Eberly, M. J. Konopnicki, and B. W. Shore (California Univ., Lawrence Livermore Lab.) 1980 8 p refs Presented at Intern. Quantum Electron. Conf., Boston, 23 Apr. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84259-Rev-1; CONF-8004106-1-Rev-1) Avail: NTIS HC A02/MF A01

The proposal of Makarov, Cantrell, and Louisell regarding stimulated inelastic resonance fluorescence is shown to not accurately represent the effects of propagation on off resonant excitation of two level model molecular absorbers. DOE

N81-11804# Idaho National Engineering Lab., Idaho Falls.
GAMMA SCATTERING
A. G. Baker 1980 25 p refs Presented at the Review Group Conf. on Adv. Instrumentation for Reactors Safety Res., Oak Ridge, Tenn., 29-31 Jul. 1980
(Contract DE-AC07-76ID-01570)
(CONF-800747-3) Avail: NTIS HC A02/MF A01

Experimental examinations were performed on a gamma scattering source/detector configuration that is believed to have the potential for providing density information at a finite number of positions along the primary beam and the average attenuation along the exit rays from those positions. Scattering spectra were acquired for several void fluid density distribution simulations. The multiple-scattered photon contribution to the total acquired spectrum from a water filled pipe simulation was extracted and found to be between 18 to 33 percent of the total counts in the single scattered photon energy region, with a region average of 24 percent. DOE

N81-11805# Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (West Germany).
SEARCH FOR COLLECTIVE PHENOMENA IN RELATIVISTIC NUCLEAR COLLISIONS
H. H. Gutbrod Jun. 1980 50 p refs Presented at the Inst. for Nucl. Studies, Fuji, Japan, 1-4 Jul. 1980 and the Seminar on High Energy Nucl. Interactions and Properties of Dense Nucl. Matter, Hakone, Japan, 7-11 Jul. 1980 Prepared in cooperation with Lawrence Berkeley Lab., Calif.
(Contract W-7405-eng-48)
(LBL-11123; CONF-800709-3) Avail: NTIS HC A03/MF A01

The weakness of the fireball/fire streak model is illustrated. The single-particle spectra of nucleons, clusters, and pions are discussed, and then attention is focused on the fate of the target nucleus and possible evidence of collective phenomena. Data on central collisions that reflect the nature of the energy flux in the target nucleus are discussed. DOE

N81-11806# Department of Energy, Washington, D. C. Center for Particle Theory.
RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY, 1979 - 1980 Progress Report
E. C. G. Sudarshan and Y. Neeman 1980 98 p
(Contract DE-AS05-76ER-03992)
(DOE/ER-03992/392) Avail: NTIS HC A05/MF A01

A qualitative description is given of research in particle theory. Research in particle physics in relativistic astrophysics and cosmology; phenomenology of weak and electromagnetic interactions; strong interaction physics and quark-parton physics; quantum mechanics, quantum field theory, and fundamental problems; and groups, gauges, and grand unified theories is described. DOE

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N81-11807# Naval Research Lab., Washington, D. C.
COMPUTER SIMULATION OF INTENSE ELECTRON BEAM GENERATION IN A HOLLOW CATHODE DIODE Memorandum Report, Jun. - Dec. 1978
R. J. Barker, Shyke A. Goldstein, and Roswell E. Lee 5 Sep. 1980 31 p refs
(AD-A089854; NRL-MR-4279) Avail: NTIS HC A03/MF A01 CSCL 20/7

A modified version of NRL's DIODE 2 D computer simulation code is used to model the electron and proton flow in a hollow cathode diode. Results correspond closely to those observed in experiments performed at NRL and give direct insight into the diode physics. The strong dependence of diode performance on two dimensional distortions of the A-K gap electric field as well as upon the presence of a strong axial magnetic field is clearly illustrated. GRA

N81-11808# Los Alamos Scientific Lab., N. Mex.
RADIOCHEMICAL ANALYSES OF SAMPLES FROM BENEATH A SOLID RADIOACTIVE WASTE DISPOSAL PIT AT LOS ALAMOS, NEW MEXICO
W. D. Purtyman, M. A. Rogers, and M. L. Wheeler Jun. 1980 18 p refs
(Contract W-7405-eng-36)
(LA-8422-MS) Avail: NTIS HC A02/MF A01

Core samples from beneath solid radioactive wastes disposed of by burial in pits excavated in rhyolite tuff are analyzed. Contaminants in the waste include fission products, uranium, and transuranic elements. Samples of the core were analyzed for gross alpha, gross beta, total uranium, 90Sr, 137Cs, 238Pu, and 241Am. The measured gross alpha, gross beta, and uranium concentrations are above minimum detection limits; concentrations of the remaining radionuclides, all of which are man-made isotopes, are below the minimum detection limits. Statistical comparisons are made of the gross alpha, gross beta, and uranium data to identify any significant variations from natural concentrations in the tuff. The comparisons demonstrate that none of the radioactivity detected in the samples can be attributed to migration from the disposal pit. DOE

N81-11809# Sandia Labs., Albuquerque, N. Mex. Div 4536.
SYSTEMS ENGINEERING PROGRAMS FOR GEOLOGIC NUCLEAR WASTE DISPOSAL

Robert D. Klett, Eugene S. Hertel, Jr., and Molly A. Ellis Jun. 1980 136 p refs Prepared in cooperation with Dikewood Corp., Albuquerque
(Contract DE-AC04-76DP-00789)
(SAND-80-0440) Avail: NTIS HC A07/MF A01

The design sequence and system programs presented begin with general approximate solutions that permit inexpensive analysis of a multitude of possible wastes, disposal media, and disposal process properties and configurations. It then continues through progressively more precise solutions as parts of the design become fixed, and ends with repository and waste form optimization studies. The programs cover both solid and gaseous waste forms. The analytical development, a program listing, a users guide, and examples are presented for each program. Sensitivity studies showing the effects of disposal media and waste form thermophysical properties and repository layouts are presented as examples. DOE

N81-11810# Rockwell International Corp., Richland, Wash. Hanford Operations.
INSPECTION AND EVALUATION OF NUCLEAR FUEL SERVICES HIGH-LEVEL WASTE STORAGE SYSTEM, PROGRAM PLAN
Jan. 1980 64 p refs
(Contract DE-AC06-77RL-01030)
(RHO-CD-882) Avail: NTIS HC A04/MF A01

Information concerning the condition of the high-level waste tanks at the Western New York State Nuclear Service center near West Valley, New York is presented. This information is to be used in evaluating the safety of continued storage and in the development of alternatives for final disposition of the high-level waste. DOE

N81-11811# Battelle Pacific Northwest Labs., Richland, Wash.
VITRIFICATION OF RADIOACTIVE HIGH-LEVEL WASTE BY SPRAY CALCINATION AND IN-CAN MELTING
M. S. Hanson and W. J. Bjorklund Jul. 1980 87 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3145) Avail: NTIS HC A05/MF A01

After several nonradioactive test runs, radioactive waste from the processing of 1.5 t of spent, light water reactor fuel was successfully concentrated, dried and converted to a vitreous product. A total of 97 L of waste glass (in two stainless steel canisters) was produced. The spray calcination process coupled to the in-can melting process, as developed at Pacific Northwest Labortory, was used to vitrify the waste. An effluent system consisting of a variety of condensation of scrubbing steps more than adequately decontaminated the process off gas before it was released to the atmosphere. DOE

N81-11812# Rockwell International Corp., Richland, Wash. Systems Engineering Dept.
IDENTIFICATION OF KEY RADIONUCLIDES IN A NUCLEAR WASTE REPOSITORY IN BASALT
G. Scott Barney and Bernard J. Wood May 1980 33 p refs
(Contract DE-AC06-77RL-01030)
(RHO-BWI-ST-9) Avail: NTIS HC A03/MF A01

Radionuclides were identified which appear to pose the greatest potential hazard to man during long term storage of nuclear waste in a repository mined in the Columbia Plateau basalt formation. The criteria used to select key radionuclides were as follows: quantity of radionuclide in stored waste; biological toxicity; leach rate of the wastes into groundwater; and transport rate via ground water flow. The waste forms were assumed to be either unreprocessed spent fuel or borosilicate glass containing reprocessed high level waste. The nuclear waste composition was assumed to be that from a light water reactor. Radionuclides were ranked according to quantity, toxicity, and release rate from the repository. These rankings were combined to obtain a single list of key radionuclides. Dissert. Abstr.

N81-11813# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
RESEARCH IN THEORETICAL NUCLEAR PHYSICS Progress Report and Research Proposal, 1980 - 1981
B. F. Bayman, P. J. Ellis, and Y. C. Tang 1 Sep. 1980 26 p refs
(Contract DE-AC02-79ER-10364)
(DOE/ER-10364/13) Avail: NTIS HC A03/MF A01

Research performed during 1980 (and proposed for 1981) is summarized briefly. The main theme of the research is the mechanisms of light and heavy ion nuclear reactions and the relation between microscopic theories and phenomenological models. A publication list and budget are included. DOE

N81-11814# California Univ., Berkeley. Lawrence Radiation Lab. Nuclear Science Div.
NUCLEAR STRUCTURE AT HIGH ANGULAR MOMENTUM
F. S. Stephens Jun. 1980 110 p refs Presented at the Nucl. Phys. Workshop, Tandar Project, Comision Nacional de Energia Atomica, Argentina, 7-18 Apr. 1980
(Contract W-7405-eng-48)
(LBL-10957) Avail: NTIS HC A06/MF A01

The limits faced in the attempts to get nuclei to hold very high angular momentum are discussed and the method presently used to produce nuclei with the maximum angular momentum is described. The physics of high spin states, some properties of a purely collective, classical rotor, and the effects of coupling single particle motion to this are considered. Backbending, its causes, and a new spectroscopy of bands and backbends at high spin values are discussed. Noncollective states occur when the nuclear angular momentum is carried by a few high-j particles and is aligned along a symmetry axis. There results an irregular yrast line, along which there are no collective transitions. Noncollective behavior in lead region, the hafnium region, and the N = 82 region is examined. Collective behavior and recent studies on continuum spectra are examined. Evidence for rotation is given, and effective moments of inertia for this rotation are evaluated. Current gamma ray energy correlation studies are described. DOE

N81-11815# California Univ., Livermore. Lawrence Livermore Lab.
HAZARD INDEX FOR UNDERGROUND TOXIC MATERIAL
Craig F. Smith, Jerry J. Cohen, and Thomas E. McKone (California Univ., Los Angeles) Jun. 1980 151 p refs
(Contract W-7405-eng-48)
(UCRL-52889) Avail: NTIS HC A08/MF A01

Work in the area of hazard indices was reviewed. A geotoxicity hazard index for use in characterizing the hazard of toxic material buried underground is presented. Factors included in this index are: an intrinsic toxicity factor, formulated as the volume of water required for dilution to public drinking water levels; a persistence factor to chracterize the longevity of the material, ranging from unity for stable materials to smaller values for shorter lived materials; an availability factor that relates the transport potential for the particular material to a reference value for its naturally occurring analog; and a correction factor to accommodate the buildup of decay progeny, resulting in increased toxicity. DOE

N81-11816# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
EVALUATION AND REVIEW OF ALTERNATIVE WASTE FORMS FOR IMMOBILIZATION OF HIGH LEVEL RADIOACTIVE WASTES
1 Jun. 1980 32 p refs
(Contract DE-AC09-76SR-00001)
(DOE/TIC-11219) Avail: NTIS HC A03/MF A01

The relative merits and potential of 15 alternative waste forms being considered for the solidification and disposal of radioactive wastes were reviewed. The relative merits of 4 alternative presolidification processing approaches were also assessed in this study. A numerical rating of alternative waste forms was arrived at individually by the panel members taking into consideration 9 scientific and 9 engineering parameters affecting the long term performance and production of waste forms. Three final ranking lists comparing: Present Scientific Merits or Least Risk for Use Today; Research Priority; and Present and Potential Engineering Practically were prepared by the Panel. Each waste form in the lists was assigned a value of either Top Rank, Intermediate Rank, or Bottom Rank. DOE

N81-11817# Los Alamos Scientific Lab., N. Mex. Advanced Nuclear Systems and Projects Div.
GENERAL-PURPOSE HEAT SOURCE PROJECT AND SPACE NUCLEAR SAFETY AND FUELS PROGRAM Progress Report

W. J. Maraman, comp. Jul. 1980 27 p ref
(Contract W-7405-eng-36)
(LA-8454-PR) Avail: NTIS HC A03/MF A01

The studies related to the use of (Pu-238)O2 in radiosotopic power systems are discussed. The two programs, general purpose heat source development and space nuclear safety and fuels are described. Most of the studies discussed here are of a continuing nature. Results and conclusions described may change as the work continues. DOE

N81-11818# Iowa State Univ. of Science and Technology, Ames.
MULTIPLE SCATTERING THEORY AND APPLICATIONS FOR INTERMEDIATE ENERGY REACTIONS OF NUCLEI Ph.D. Thesis
Larry D. Ludeking 1979 154 p refs
(Contract W-7405-eng-82)
(IS-T-883) Avail: NTIS HC A08/MF A01

Interactions of two composite clusters are treated in a multiple scattering framework whereby many particle operators are decomposed into a systematic and finite series such that there is an ordered sequestering according to particle rank. It is demonstrated how the transition operator, a reaction operator, and an optical potential may be described in this context. The general structure of such decompositions is shown, and the connection to the standard multiple scattering prescriptions, delineated. The direct reaction amplitude for stripping and pickup is described, and the two potential formula of Gell-Mann and Goldberger is derived. The multiple scattering formalism for direct reactions is constructed in the eikonal approximation. The sensitivity of the transition cross section to the target density and nucleon-nucleon density correlations are examined in this framework. The limitation of the zero range approximation to the deuteron vertex function are examined by comparison with the finite range vertex function at a range of energies. DOE

N81-11819# Hughes Research Labs., Malibu, Calif.
NEUTRAL BEAM SOURCE COMMERCIALIZATION STUDY Final Report
H. J. King Jun. 1980 70 p refs
(Contract W-7405-eng-48)
(LBL-11261) Avail: NTIS HC A04/MF A01

A set of design drawings suitable for quantity production were generated. A functional neutral beam source incorporating as many of the proposed design changes as proved feasible was fabricated. The procedures and findings developed during the contract are described. DOE

74 OPTICS

Includes light phenomena.

N81-11820 Stanford Univ., Calif.
INCOHERENT OPTICAL MATRIX-VECTOR MULTIPLICATION FOR HIGH-SPEED DATA PROCESSING Ph.D. Thesis
Antonio Rainha Dias 1980 141 p
Avail: Univ. Microfilms Order No. 8026241

A new incoherent optical matrix-vector multiplier able to perform complex-valued arithmetic at very high data rates is described. The input vector is physically realized by an array of light-emitting diodes, and the output vector is measured by an array of PIN photodiodes. The matrix is properly encoded and stored in a transparent mask. The first experimental realizations of this type of system are described--a conventional realization using discrete optical components and a very compact planar waveguide realization. Experimental results are presented and discussed. The influences of nonlinearities and errors in the optical realization on the system performance were examined theoretically. Two very comprehensive approaches to performance evaluation were followed. The first was a deterministic approach involving testing of the system with typical input signals. The second utilized very general stochastic models for the system and the input vector. Dissert. Abstr.

N81-11821# Avco-Everett Research Lab., Mass.
AMOS PHASE 4 PROGRAM Interim Report, 1 Jan. 1978 - 31 Dec. 1978
J. Chapman and P. McCormick Apr. 1980 240 p
(Contract F30602-78-C-0061; ARPA Order 2837; AF Proj. 2837)
(AD-A088924; AERL-TR-1025; RADC-TR-80-115) Avail: NTIS HC A11/MF A01 CSCL 17/5

This report summarizes the activities which have occurred at the ARPA Maui Optical Site (AMOS) during the period 1 Jan 78 through 31 Dec 78. These activities have taken advantage of the AMOS Facility which was developed by APRA and now serves as a multipurpose advanced optical testbed. This report contains a complete summary of the development of AMOS, a description of the assets available and summarizes the major accomplishments. GRA

N81-11822# General Electric Co., Santa Barbara, Calif. TEMPO.
PROCEEDINGS OF THE FIBER OPTICS IN THE NUCLEAR ENVIRONMENT SYMPOSIUM, 25-27 MAR. 1980. VOLUME 2: RADIATION PHYSICS
R. C. Webb 30 Apr. 1980 241 p refs Proceedings held at Santa Barbara, Calif.
(Contract DNA001-79-C-0081)
(AD-A089725; DNA-5308P-2) Avail: NTIS HC A11/MF A01 CSCL 20/6

Contents: Radiation-Induced Defect Centers in Fiber Optic Glasses; The Role of the Multidopants Sb/P in Radiation Hardening of Optical Fibers; Radiation Damage of Optical Fiber Waveguides at Long Wavelengths; Temperature Dependence of Radiation Darkening in Optical Waveguides; Radiation Performance of Germanium Phosphosilicate Optical Fibers as a function of Temperature; Fast Recovery in Optical Fibers Exposed to Pulsed Radiation; Short-Term Radiation Effects in Optical Fibers; Radiation Response Measurement of Fibers in the Picosecond Region; Photobleaching Effects in Optical Fiber Waveguides; Electron-Beam Induced Absorption and Hardening in Fiber-Optic Waveguides to 1060-NM Laser Pulses; Characterization of Low-Loss Multimode Optical Fibers for Nuclear Diagnostics; Radiation Degradation and Recovery in Long Fiber-Optics Data Links; Neutron Damage Effects in Ga sub 1-x Al sub x As LEDs; Temperature Dependence of Neutron Damage to Commercial GaAsP LED Devices; Transient Effects of Ionizing Radiation in Si, InGaAsP, GaAlSb, and Ge Photodiodes; and A Radiation-Hardening Scheme for an Analog Fiber-Optic Data Link. GRA

N81-11823# Photometrics, Inc., Lexington, Mass.
FURTHER ASSESSMENT OF INFRARED DATA FROM AIRCRAFT AND ROCKET PROBES Final Report, 1 Dec. 1978 - 31 Oct. 1979
I. L. Kofsky and D. P. Villanucci 30 Nov. 1979 138 p refs
(Contract DNA001-79-C-0013)
(AD-A089724; PHM-05-79; DNA-5127F) Avail: NTIS HC A07/MF A01 CSCL 04/1

Measurements from an aircraft and rockets of the yield of 2.8-3.1 micrometers-band photons from air irradiated by ionizing particles are evaluated. The night-time column emission in aurora, viewed from below by a sensitive radiometer with less than 1 km field of view, is found to be temporally-spatially correlated with the column energy input to within a few sec and a few km. The 'equilibrium' chemiluminous efficiency in the SWIR band, measured with lower-resolution instruments in several hr of flight, shows statistically-significant variations of about a factor two (data from 1976 missions, reported in HAES 79, lie in a narrower range). Its mean value is very near that expected from laboratory and HAES rocket measurements. Altitude profiles of the SWIR photon yield from two DNA/AFGL rockets have a pronounced minimum near 110 km altitude, qualitatively similar to that predicted by models of collisional quenching of vibrationally-excited nitric oxide molecules by oxygen atoms. Preliminary results of the aircraft's photometric (including airglow-sensitive video) and radiometric measurements on the ionospheric plasma depleton produced by release of H2 and H2O from an Atlas Centaur rocket engine are presented. GRA

N81-11824# Sperry Rand Research Center, Sudbury, Mass.
DEVELOPMENT OF LIQUID CRYSTAL AND MAGNETIC STRIPE DOMAIN MULTIMODE OPTICAL SWITCHES Final Technical Report, 29 Mar. 1979 - 28 Mar. 1980
R. A. Soref, , and M. Kestigian Jul. 1980 126 p refs
(Contract F19628-79-C-0086; AF Proj. 4600)
(AD-A090124; SRC-CR-80-25; RADC-TR-80-217) Avail: NTIS HC A07/MF A01 CSCL 20/6

Two fiber optical switching devices have been investigated: A device using liquid crystals and one with magnetic stripe-domain structures. The device based on liquid crystals has been developed to the point where prototypes are now available. This work is extremely successful and will be of great importance to the future optical fiber communications of the Air Force. The study of the magnetic stripe-domain structures was not completed but significant and original technical progress was achieved which merits future investigations. GRA

N81-11825# Yuma Proving Ground, Ariz.
INFRARED TARGET ARRAY DEVELOPMENT Final Report, Oct. 1978 - Mar. 1980
Edward A. Scott Apr. 1980 71 p refs
(AD-A089896; YPG-397) Avail: NTIS HC A04/MF A01 CSCL 17/5

The US Army Yuma Proving Ground (USAYPG) was requested to develop and acquire a series of infrared targets with controllable thermal signatures to support the test and evaluation of the Target Acquisition Designation System/Pilot Night Vision System (TADS/PNVS) subsystems of the Advanced Attack Helicopter (AAH) Fire Control System. Prior to this development effort, no capability beyond the use of real-scene targets existed at USAYPG to provide thermally active targets with characteristic signatures in the infrared band. Three targets were acquired: (1) a detection target; (2) a recognition target; and (3) a laser scoring board. It is concluded that design goals were met and the system was delivered in time to perform its function. The system provides sufficient thermal realism and has advanced the state-of-the-art of infrared imaging system test and evaluation. It is recommended that the Field Equivalent Bar Target (FEBT) system be validated as a potential test standard and that environmentally 'hardened' targets be acquired for continued thermal sight testing. GRA

N81-11826# Defence Research Establishment Valcartier (Quebec).
EVALUATION OF A CLASS OF SEGMENTERS FOR IR IMAGERY
L. Sevigny May 1980 81 p refs
(AD-A089907; DREV-R-4172/80) Avail: NTIS HC A05/MF A01 CSCL 17/5

This report presents an evaluation of the performance of 6 algorithms dedicated to segmentation of targets in IR imagery. These segmentation algorithms or segmenters are based on the single assumption that the targets display a larger thermal signature than the background. The first 3 segmenters deal with an image in its entirety, whereas the last 3 incorporate the Background Elimination Technique (BET), which aims at eliminating wholly or partly the background by levelling it. The segmenters are judged according to (a) their extraction rate; (b) the fidelity of the segmentation with respect to the geometrical properties of the extracted targets; and (c) the degree of distinctiveness imparted to the extracted targets as opposed to the nontargets. The 3 segmenters relying on BET have a better extraction rate than the other 3 that try to cope with the background simply by partitioning the image. Most segmenters here distort in one way or another the shape of the targets. The two exceptions are segmenter No. 1 (Single Intensity Threshold Silhouette Generator or SIT Generator) and No. 6 (SIT Generator in conjunction with a particular version of BET). The experimental results show that the intensity, contrast and variance features are the most effective in discriminating the targets from the nontargets. GRA

N81-11827# Argonne National Lab., Ill.
LARGE SCINTILLATION COUNTER DESIGN WITH WAVESHIFTER LIGHT COLLECTION
George Theodosiou and Walter Selove (Pennsylvania Univ., Philadelphia) 9 May 1980 9 p refs Presented at the Intern. Conf. on Exptn. at LEP, Uppsala, 16-20 Jun. 1980
(Contract DE-AC02-76ER-03071)
(COO-3071-244; ANL-HEP-PR-80-27; CONF-800684-3) Avail: NTIS HC A02/MF A01

The light collection method, scintillation and waveshifter materials, number of photoelectrons calculation, and time resolution for a scintillator hodoscope of very large dimensions are described. This equipment is used for particle counting and time of flight applications and is about 5 times less expensive than aromatic scintillators. The time resolution is about + or - 2/3 sec. DOE

N81-11828# Oak Ridge National Lab., Tenn. Health and Safety Research Div.
SOFT X-RAY TRANSMISSION GRATINGS
E. T. Arakawa (Tennessee Univ., Knoxville), P. J. Caldwell, and M. W. Williams 1980 5 p refs Presented at the SPIE, San Diego, Calif., 28 Jul. 1980
(Contract W-7405-eng-26)
(CONF-800719-11) Avail: NTIS HC A02/MF A01

A technique developed for producing transmission diffraction gratings suitable for use in the soft X-ray region is discussed. Thin self-supporting films of a transparent material are overlaid with several thousand opaque metallic strips per mm. Gratings with 2100, 2400, and 5600 i/mm have been produced and tested. Representative spectra over the wavelength range from 17.2 to 40.0 nm are given for a grating consisting of a 120-nm-thick Al support layer overlaid with 2400, 34-nm-thick, Ag strips/mm. The absolute transmittance is 13% at 30 nm, and the efficiency in the first order is 16%. The observed resolution of 2A is acceptable for many of the potential applications. These gratings have several advantages over the two presently available alternatives in the soft X-ray region. Fabrication is relatively quick, simple, and cheap. The support layer can also serve as a filter and help conduct excessive heat away. Higher line densities and hence higher resolutions are possible, and when used at normal incidence the spectra are aberration free. DOE

N81-11829# California Univ., Livermore.
TEMPERATURE MEASUREMENTS OF SHOCKED ENERGETIC MATERIALS BY TIME REVOLVED INFRARED RADIOMETRY
William G. VonHolle 1980 21 p refs Presented at the NATO Adv. Study Inst. on Fast Reactions in Energetic Systems, Ionannina, Greece, 7-19 Jun. 1980
(Contract W-7405-eng-48)
(UCRL-84587; CONF-800714-2) Avail: NTIS HC A02/MF A01

Temperatures of solid explosive and propellants were measured in 102 mm projectile impact experiments using two band, time resolved infrared radiometry. Two different arrangements were used. In one, temperature measurements were made on the downstream face of bare charges; in the other, the material was confined by a shock impedance matched, infrared transmitting window. The bare charge results yield temperature histories consistent with formation and decay of hot spots, and different particle sizes resulted in large differences in behavior, which were interpreted in terms of hot spot theory. Window confinement provided reaction histories and rate data which constitute a new measurement of progress of reaction in shock initiation. DOE

N81-11830# Rochester Univ., N. Y. Inst. of Optics.
DEVELOPMENT OF FERROMAGNETIC SPINELS FOR OPTICAL ISOLATION AT 10.6 MU M
K. J. Teegarden May 1980 269 p refs
(Contract DE-AS02-76DP-40050)
(DOE/DP-40050/9) Avail: NTIS HC A11/MF A01

Vacuum hot pressing was used to fabricate CdCr2S4, CdCr2Se4 and (1-x) CdCr2S4 x CdCr2Se4 discs with diameters of 1.25 cm from fine powders and small single crystals to relative densities as high as 99.6%. Optical attenuation coefficients of approximately 10 cm at 10.6 m were obtained for CdCr2S4, and values of 12.1 cm and 14.9 cm for the selenide and sulfur selenide mixture. Two and three phonon absorption bands were found to limit the transmission of CdCr2S4 at lambda > 10 micrometers. Extrinsic absorption mechanisms caused the higher attenuation coefficients in CdCr2Se4 and the mixture. The main extrinsic mechanisms at long wavelengths were free carrier absorption (in CdCr2Se4) and an impurity absorption band at 16.3 micrometers due to Cr2O3. At short wavelengths the

attenuation coefficient was dominated by scattering from pores, and second phases. Free carier absorption was found to be induced by free selenium present in the starting powders. Other significant results are reported. DOE

N81-12001*# Columbus Coll., Ga.
A MONTE CARLO APPROACH TO TOLERANCE ANALYSIS OF A NEAR-DIFFRACTION LIMITED OPTICAL IMAGING SYSTEM
W. Harold Davenport *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 16 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N81-11831 Dartmouth Coll., Hanover, N.H.
DRIFT WAVES IN A NONUNIFORMLY ROTATING PLASMA COLUMN Ph.D. Thesis
Elizabeth Marden-Marshall 1980 224 p
Avail: Univ. Microfilms Order No. 8024290

The collisional drift instability, which is observed in a weakly ionized argon plasma, is compared to a cylindrical two fluid model which allows for arbitrary density profiles and a sheared E x B rotation of the plasma. The drift waves are repetitively pulsed on and off, and the evolution of the radial wave and density profiles documented. The early stages of growth represent a linear regime, and it is here that experimental measurements are made for comparison with the linear theory. In particular, real frequency, growth rate, and radial wave shape are compared. Results indicate that both rigid body and sheared column rotation Doppler shift the real frequency, that both are destabilizing, but that neither has a noticeable effect on the shape or localization of the radial eigenmode. Dissert. Abstr.

N81-11832 Columbia Univ., New York.
QUENCHING OF ELECTRIC ARC-GENERATED AIR PLASMA EFFLUENT Ph.D. Thesis
Yin-Pang Tsui 1980 167 p
Avail: Univ. Microfilms Order No. 8023555

A Sheer-Korman type of electric arc was constructed to provide high temperature air and an equimolar mixture of oxygen and nitrogen. The methods of free expansion cooling and turbulent cold gas mixing were evaluated based upon their ability to cool the plasma effluent. The results demonstrated the failure of the free expansion probe as a quenching device. The cause of the failure was diagnosed as recompression shock heating. The success of the turbulent cold gas mixing probe established conclusively that nitric oxide concentration in the quenched product is a linear function of the quenching efficiency. This relationship was determined between the stagnation temperature range between 2350 K and 2600 K, and feed compositions of air and an equimolar mixture of oxygen and nitrogen. Furthermore, at sufficiently efficient quenching, the nitric oxide concentration in the product surpassed those that would have been expected from equilibrium considerations based on the feed and stagnation conditions. It is concluded that excited species are present in plasma tail flames at appreciable concentrations even at relatively low temperatures. Dissert. Abstr.

N81-11833*# Wichita State Univ., Kans. Dept. of Mechanical Engineering.
PERFORMANCE PREDICTION OF STRAIGHT TWO DIMENSIONAL DIFFUSERS Final Report
Mahesh S. Greywall Sep. 1980 35 p refs
(Contract NsG-3186; Contract DE-AI01-77ET-10769)
(NASA-CR-165186; DOE/NASA/3186-1; ME-MG80-1) Avail: NTIS HC A03/MF A01 CSCL 20I

A method, based on full viscous calculations, is presented to predict performance of straight two dimensional diffusers. The method predicts adequately the experimental pressure recovery data, up to the point of maximum pressure recovery, for small and large inlet boundary layer thicknesses. It is shown that at the point of maximum pressure recovery the streamwise velocity in the very near wall region varies as Z to the 0.22 power, where Z is the distance from the diffuser wall. Author

N81-11834*# Texas Univ., Arlington.
MHD GENERATOR OFF-DESIGN PERFORMANCE AND NOx CHEMICAL KINETICS ANALYSIS. VOLUME 1: ANALYSIS OF THE OFF-DESIGN PERFORMANCE OF THE ENGINEERING TEST FACILITY ETF MHD GENERATOR FLOW TRAIN
Donald R. Wilson and Gloyd A. Simmons Jun. 1980 77 p refs
(Grant NsG-3255)
(NASA-CR-165187; DOE/NASA/3255-1) Avail: NTIS CSCL 20I

A computer code for performing parametric design point calculations, and evaluating the off design performance of magnetohydrodynamic generators was developed. Details of the computer codes are presented. An assessment of the effect of preheat, stoichiometry, and oxygen enrichment on the design point electrical performance of the generator, and the NOx concentration at the exit of the radiant boiler are included. The off design study included variations in mass flow rate and oxygen enrichment. Maximum design point performance was achieved with a combination of high preheat, high stoichiometry, and no oxygen enrichment. The reduction in generator power was found to scale almost quadratically with the mass flow rate reduction. The power increased to a maximum level for off design operation at an oxygen enrichment value of 60 percent, then decreased with further increases in oxygen enrichment. The off design generator would not run at oxygen enrichment levels less than the 50 percent design level and simultaneously match the imposed thermal power input and downstream pressure constraints. S.F.

N81-11835# Nagoya Univ. (Japan). Inst. of Plasma Physics.
A RELAXED CONDITION FOR PURELY OHMIC IGNITION IN REVERSED FIELD PINCH CONFIGURATIONS
K. Ikuta Jul. 1980 18 p refs
(IPPJ-472) Avail: NTIS HC A02/MF A01

The conditions for purely ohmic ignition in reversed field pinch configuration are considered in detail. The necessary current for ignition is significantly relaxed if the hot core is sufficiently concentrated near the center of the plasma column. Author

N81-11836# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ANOMALOUS VISCOSITY DUE TO WEAK TURBULENCE IN IMPLODING TARGET PLASMA
T. Abe and K. Niu Aug. 1980 25 p refs
(IPPJ-473) Avail: NTIS HC A02/MF A01

The plasma with stress tensor was shown to be unstable for the ion acoustic mode in addition to the electromagnetic mode. These unstable modes are saturated by nonlinear effects and constitute steady turbulent states. The fluctuations in the derived turbulence take a role of effective collisions for ions and electrons in a plasma, and cause the anomalous viscosity. In the imploding target plasma of ICF, this anomalous mechanism reduced the viscosity to about 0.02 times the classical one.
Author

N81-11837# Nagoya Univ. (Japan). Inst. of Plasma Physics.
TEARING MODES IN A CURRENT SHEET WITH WEAK NORMAL MAGNETIC FIELD
Ken-Ichi Nishikawa and Jun-Ichi Sakai (Toyama Univ.) Aug. 1980 23 p refs
(IPPJ-474) Avail: NTIS HC A02/MF A01

A set of coupled eigenmode equations in a current sheet with the weak normal magnetic field was solved numerically. Due to the effect of normal magnetic field, a series of vortexes appeared in the magnetic island. This tearing mode can grow much faster than the usual tearing mode. Author

N81-11838# Nagoya Univ. (Japan). Inst. of Plasma Physics.
OBLIQUE COLLISION OF PLANE ION-ACOUSTIC SOLITONS
Yasushi Nishida and Takeshi Nagasawa Sep. 1980 14 p refs
(IPPJ-475) Avail: NTIS HC A02/MF A01

Nonlinear evolutions of oblique collision are investigated experimentally on the plane ion-acoustic solitons in two dimen-

sional space. The characteristics of inelastic collision of solitons are found to be similar to those of resonance interactions described by nonlinear ion acoustic waves. Author

N81-11839# Nagoya Univ. (Japan). Inst. of Plasma Physics.
MECHANISM FOR ION HEATING BY LOWER HYBRID WAVES
Hirotada Abe (Kyoto Univ., Japan) Sep. 1980 15 p refs
(IPPJ-476) Avail: NTIS HC A02/MF A01

The heating mechanism of ions due to lower hybrid waves is studied computationally. In lower hybrid wave heating of Tokamaks, almost all the wave energy transferred to ions is consumed in producing the high energy tail. This occurs even in the presence of moderate parametric instability. In most cases, therefore, the main heating mechanism must be reduced to collisional relaxations from the high energy tail of ion to the bulk. Author

N81-11840# Nagoya Univ. (Japan). Inst. of Plasma Physics.
SIMULATION OF PLASMA CONFINEMENT IN RF PLUGGED CUSP FIELD
Y. Ohsawa and T. Kamimura Sep. 1980 36 p refs
(IPPJ-477) Avail: NTIS HC A03/MF A01

Conditions for effective radio-frequency plugging of a cusp plasma are examined with a Monte Carlo simulation model. Both adiabatic and nonadiabatic plugging are studied. The dependence of the plugging efficiency on the machine system size, the applied frequency, and the amplitude of the rf field is clearly shown, and optimum conditions for plugging are found. Author

N81-11841# Toronto Univ., Downsview (Ontario).
AN EXPERIMENTAL STUDY OF NONSTATIONARY INSTABILITIES OF PLANAR SHOCK WAVES IN IONIZING ARGON
W. L. Buchanan Aug. 1980 89 p refs
(Grant AF-AFOSR-3303-77)
(UTIAS-TN-222; CN-ISSN-0082-5263) Avail: NTIS HC A05/MF A01

A multipulse laser-Schlieren technique was used to study the time behavior of instabilities in the translational front of planar shock waves in ionizing argon in the 10 x 18 cm hypervelocity shock tube at UTIAS. Using a ruby laser in a combined normal-lasing/giant-pulse mode, at least two monochromatic light pulses were obtained about 7 microns apart. A Schlieren system compatible with the 23 cm dia Mach-Zehnder interferometer was created with maximum sensitivity for some low-density conditions. The almost-sinusoidal perturbations were found to change with time; some like a standing wave, and others like a travelling wave. It was not, however, possible to associate the observed perturbations with either form of wave motion in nearly half of the cases. A simple graph provides a way to predict the shape of the perturbations from the shock-wave parameters. Author

N81-11842# Texas Technological Univ., Lubbock. Plasma Lab.
DENSE PLASMA HEATING AND RADIATION GENERATION Final Report, 1 Jan. 1974 - 30 Apr. 1980
M. Kristiansen and M. O. Hagler 30 May 1980 45 p refs
(Grants AF-AFOSR-2639-74; AF-AFOSR-0034-79; AF Proj. 9752; AF Proj. 2301)
(AD-A089779; AFOSR-80-0481TR) Avail: NTIS HC A03/MF A01 CSCL 20/9

The research conducted consisted of three related studies of the interaction of a laser with plasmas and solids. These studies were: (1) experimental and theoretical investigations of laser-plasma interactions, (2) experimental investigations of nonlinear optical mixing in a dense plasma, and (3) experimental investigations of solid-laser-plasma interactions. In addition, a survey was made of pulsed power techniques. A computer code has been developed to predict the interaction of a focused or collimated laser beam with a dense, fully ionized, hydrogen plasma. A laboratory constructed plasma source was designed and constructed to test the validity of this code. The results were informative, but indicated that this heating method only is useful under very stringent plasma parameter controls. In the laser-plasma-pellet experiment, a ruby laser was focused onto a polystyrene pellet positioned in a dense theta pinch plasma. The gas cloud ablated by the plasma and laser was studied, along with the effects on the pellet. A comparison with theory was also made. The agreement was, again, good. The survey of pulsed power techniques was made to provide a reference source for some of the important concepts in this field. GRA

N81-11843# Naval Research Lab., Washington, D. C.
TRANSPORT STUDIES IN REVERSED FIELD THETA PINCHES
Wallace M. Manheimer and John M. Finn 25 Sep. 1980 32 p refs
(Contract EX-76-A-34-1006)
(AD-A089855; NRL-4348) Avail: NTIS HC A03/MF A01 CSCL 20/9

This paper examines anomalous transport in a reversed field theta pinch. The principal effects are anomalous resistivity and rotation generation. Similarity solutions for the resistive decay are found which agree qualitatively with experiment. Also it is shown that the spin up and anomalous resistivity may be the effect of a single underlying cause, a current driven microinstability. GRA

N81-11844# Naval Research Lab., Washington, D. C. Plasma Physics Div.
SPHEROMAK TILTING INSTABILITY IN CYLINDRICAL GEOMETRY
John M. Finn (Science Applications, Inc., McLean, Va.), Wallace M. Manheimer, and Edward Ott (Maryland Univ., College Park) 25 Sep. 1980 27 p refs
(Contract EX-76-A-34-1006)
(AD-A090034; NRL-MR-4316) Avail: NTIS HC A03/MF A01 CSCL 18/1

The compact torus, or spheromak, approach to magnetic fusion has numerous advantages as a reactor over Tokamak designs. Most important of these are relative compactness, the fact that a toroidal blanket is not necessary, and the absence of external toroidal field coils. Theoretical work by Rosenbluth and Bussac has shown that a spheromak plasma in a tight fitting spheroidal shell is unstable to a magnetohydrodynamic mode which they call the internal tilting mode if the boundary is slightly elongated, i.e., prolate. Recently, a spheromak-type configuration has been formed at the University of Maryland by a combination of Z-pinch and theta pinch technologies. Although the spherical wall equilibrium of Ref. 2 describes this device in a qualitative fashion, a more appropriate theoretical model for the Maryland device is an equilibrium with cylindrical conducting walls and endplates. In addition, we feel that it is of value to show that the tilting instability is not specific to systems with conducting walls that are almost spherical. Detailed comparison of the model with the experimental device and the observed tilting instability with the theory has been presented elsewhere. In this paper we describe in more detail two of the theoretical approaches used and their justification. GRA

N81-11845# Spire Corp., Bedford, Mass.
TECHNIQUES FOR THE SIMULATION OF THE SPACE PLASMA ENVIRONMENT
Ward D. Halverson Jun. 1980 22 p refs
(Contract F19628-80-C-0055; AF Proj. 7661)
(AD-A090022; SCIENTIFIC-1; SR-1; AFGL-TR-80-0203) Avail: NTIS HC A02/MF A01 CSCL 20/9

The effects of space plasmas with distributed spectra of particle energies can be simulated in the laboratory by combinations of monoenergetic electron and ion beams. The energy and current density of beams are calculated to match various moments of the velocity distribution function of distributed spectra. Analytical solutions have been found for one and two beam matching, respectively, of two and four velocity moments of arbitrary distribution functions. A three energy solution which matches six moments of a Maxwellian distribution is presented, as well as multiple-beam solutions for matching two-Maxwellian distributions. GRA

N81-11846# Wisconsin Univ., Madison. Dept. of Nuclear Engineering.
FIRST WALL AND CAVITY DESIGN STUDIES FOR A LIGHT ION BEAM DRIVEN FUSION REACTOR
G. A. Moses, S. I. Abdel-Khalik, D. Drake, R. L. Engelstad, G. L.

Kulcinski, R. Lewis, E. Levell, T. McCarville, L. Peranich, R. R. Peterson et al Aug. 1980 87 p refs Prepared for Sandia Labs., Albuquerque, N. Mex.
(SAND-80-7001) Avail: NTIS HC A05/MF A01

This effort includes parametric analysis of the cavity gas response as a function of the gas temperature and gas type, the first wall mechanical response as a function of the wall material and structural design, the first wall thermal response as a function of cavity gas type and wall thickness. Also included are neutronics and time dependent radiation damage studies of the first wall, taking account of neutron interactions in the pellet. There is an assessment of the cavity gas recirculation system with possible design alternatives. A novel cavity design that utilizes the effect of blast waves in a gas with a strong density gradient is introduced. Basic conclusions regarding the viability of conservative cavity design options are listed. DOE

N81-11847# Wisconsin Univ., Madison. Dept. of Nuclear Engineering.
COLLISIONLESS PLASMA FLOW THROUGH A DECREASING MAGNETIC FIELD
A. W. Bailey and G. A. Emmert Jul. 1980 13 p refs
(Contract DE-AS02-78ET-52048)
(UWFDM-362) Avail: NTIS HC A02/MF A01

Plasma flowing through a decreasing magnetic field, as in a bundle divertor, experiences a drop in potential. The decrease was calculated using a 1-D model in which the ion distribution was calculated self consistently. This was compared with the results of an earlier model developed for bundle divertors; the two solutions were in good agreement for usual values of the mirror ratio. This calculation, however, gave a continuous, well-behaved solution as the mirror ratio approaches unity, whereas the previous model gave a discontinuous result. DOE

N81-11848# Science Applications, Inc., Ames, Iowa.
PHYSICS CONSIDERATIONS OF THE REVERSED-FIELD PINCH FUSION REACTOR
R. L. Hagenson and R. A. Krakowski (Los Alamos Scientific Lab., N. Mex.) 1980 7 p refs Presented at Reversed Field Pinch Theory Workshop, Los Alamos, N. Mex., 28 Apr. - 2 May 1980
(Contract W-7405-eng-36)
(LA-UR-80-2219; CONF-800484-4) Avail: NTIS HC A02/MF A01

A conceptual engineering design of a fusion reactor based on plasma confinement in a toroidal Reversed-Field Pinch (RFP) configuration is described. The plasma is ohmically ignited by toroidal plasma currents which also inherently provide the confining magnetic fields in a toroidal chamber having major and minor radii of 12.7 and 1.5 m, respectively. The DT plasma ignites in 2 to 3 s and undergoes a transient, unrefueled burn at 10 to 20 keV for approximately 20 s to give a DT burnup of approximately 50%. Accounting for all major energy sinks yields a cost-optimized system with a recirculating power fraction of 0.17; the power output is 750 MWe(net). DOE

N81-11849# Los Alamos Scientific Lab., N. Mex.
CONCEPTUAL PHYSICS DESIGN OF A COMPACT TORUS FUSION REACTOR (CTOR)
R. L. Hagenson (Science Applications, Inc., Ames, Iowa) and R. A. Krakowski Jul. 1980 56 p refs
(Contract W-7405-eng-36)
(LA-8448-MS) Avail: NTIS HC A04/MF A01

The general approach to fusion power embodied by field reversed plasmoid configurations is reviewed within the context of a power reactor. A simple analytic formulation is developed and applied to the field reversed theta pinch as a core plasma for a thermonuclear reactor. The calculations and results are based on a minimum power constant and serve as a basis for more exact and detailed reactor modeling. DOE

N81-11850# Oak Ridge National Lab., Tenn.
EQUILIBRIUM AND BALLOONING MODE STABILITY OF AN AXISYMMETRIC TENSOR PRESSURE TOKAMAK
W. A. Cooper, G. Bateman, D. B. Nelson, and T. Kammash Aug. 1980 53 p refs
(Contract W-7405-eng-26)
(ORNL/TM-6880) Avail: NTIS HC A04/MF A01

A force balance relation, a representation for the poloidal beta (beta/sub p), and expressions for the current densities are derived from the MHD equilibrium relations for an axisymmetric tensor pressure Tokamak. Perpendicular and parallel beam pressure components are evaluated from a distribution function that models high energy neutral particle injection. A double adiabatic energy principle is derived. The energy principle is then applied to an arbitrary cross section axisymmetric Tokamak to examine ballooning instabilities of large toroidal mode number. The resulting Euler equation is remarkably similar to that of ideal MHD. Although the field bending term is virtually unaltered, the driving term is modified because the pressures are no longer constant on a flux surface. Either a necessary or a sufficient marginal stability criterion for a guiding center plasma can be derived from this equation whenever an additional stabilizing element unique to the double adiabatic theory is either kept or neglected, respectively. DOE

N81-11851# Oak Ridge National Lab., Tenn. Fusion Energy Div.
FINITE LARMOR RADIUS STABILIZATION OF BALLOONING MODES IN TOKAMAKS
K. T. Tsang Jul. 1980 26 p refs
(Contract W-7405-eng-26)
(ORNL/TM-7324) Avail: NTIS HC A03/MF A01

A ballooning mode equation that includes full finite Larmor radius effects was derived from the Vlasov equation for a circular Tokamak equilibrium. Numerical solution of this equation shows that finite Larmor radius effects are stabilizing. DOE

N81-11852# Los Alamos Scientific Lab., N. Mex.
STABLE HEATING AND BURN SIMULATIONS OF A REVERSED FIELD PINCH REACTOR
R. W. Moses, Jr. and R. A. Nebel 1980 7 p refs Presented 2d Joint Grenoble Varenna Intern. Symp. on Heating in Toroidal Plasmas, Sep. 1980 Prepared in cooperation with Illinois Univ., Urbana
(Contracts W-7405-eng-36; DE-AS02-76ET-52040)
(LA-UR-80-2500; CONF-800948-1) Avail: NTIS HC A02/MF A01

An ideal MHD stable starting and burn procedure is described in this paper. Pitch programming and a gas feed at the wall were used. This adiabatic startup is characterized by a high pitch near the minor axis and hollow current and pressure profiles. Ideally, it would be possible to have a reactor startup and burn without highly turbulent processes to deposit excessive amounts of energy on the wall. Potential problems of resistive instabilities and plasma wall interactions are discussed. DOE

N81-11853# Los Alamos Scientific Lab., N. Mex.
INERTIAL CONFINEMENT FUSION REACTOR SYSTEMS
Thurman G. Frank, Ihor O. Bohachevsky, and John H. Pendergrass 1980 18 p refs Presented at 11th Symp. on Fusion Technol., Oxford, 15-19 Sep. 1980
(Contract W-7405-eng-36)
(LA-UR-2499; CONF-800950-1) Avail: NTIS HC A02/MF A01

A variety of reactor cavity concepts, drivers, and energy conversion mechanisms were considered to realize commercial applications of ICF. A review of reactor concepts with estimates of practically achievable pulse repetition rates is presented. A survey of drivers with estimates of the requirements on reactor conditions imposed by beam propagation characteristics and an assessment of compatible driver reactor combination are also presented. DOE

N81-11854# Westinghouse Electric Corp., Pittsburgh, Pa. Fusion Power Systems Dept.
TOKAMAK BLANKET DESIGN STUDY Final Report
Oak Ridge, Tenn. ORNL Aug. 1980 192 p refs Prepared for Oak Ridge National Lab., Tenn.
(Contract W-7405-eng-26)
(ORNL/TM-7049) Avail: NTIS HC A09/MF A01

A cylindrical module concept was developed, analyzed, and incorporated in a Tokamak blanket system that includes piping systems, vacuum boundary sealing, and support structures. The design is based on the use of state of the art structural materials (20% cold worked type 316 stainless steel), lithium as the breeding

material, and pressurized helium as the coolant. The module design consists of nested concentric cylinders (with an outer diameter of 10 cm) and features direct wall cooling by helium flowing between the outer (first wall) cylinder and the inner (lithium containing) cylinder. Each cylinder can withstand full coolant pressure, thus enhancing reliability. DOE

N81-11855# Los Alamos Scientific Lab., N. Mex.
INCOMPLETE RELAXATION AND FINITE BETA PLASMAS
Leaf Turner and J. P. Christiansen 1980 6 p refs Presented at the Reversed Field Pinch Theory Workshop, Los Alamos, N.Mex., 28 Apr. - 2 May 1980 Prepared in cooperation with the United Kingdom Atomic Energy Authority, Abingdon, England
(Contract W-7405-eng-36)
(LA-UR-2043; CONF-800484-6) Avail: NTIS HC A02/MF A01

The treatment of plasma relaxation presented is a natural generalization of the earlier treatment of Taylor and yields predictions of finite beta plasma confinement. The analysis yields predictions for global reversed-field pinch (RFP) parameters. In qualitative accordance with the experimental evidence that RFP discharges have a cool outer region of high resistivity, plasma model which permits vanishing wall values of pressure and current density is presented. DOE

N81-11856# New York Univ., N. Y. Courant Inst. for Mathematical Sciences.
ALTERNATING DIMENSION PLASMA TRANSPORT IN THREE DIMENSIONS
Harold Grad 1979 27 p refs Presented at the 4th IRIA Intern. Symp. on Computing Methods in Sci. and Eng., Versailles, France, 10-14 Dec. 1979
(Contract DE-AC02-76ER-03077)
(COO-3077-164; CONF-791201-4; MF-95) Avail: NTIS HC A03/MF A01

The alternating dimension method of solving macroscopic adiabatic and transport problems is generalized to arbitrary three dimensional toroidal plasma confinement systems. The result is the derivation of an evolution equation for the poloidal and toroidal fluxes in which second derivatives can be explicitly exhibited to show that the system is diffusive. The eigenvalues (diffusion coefficients) are evaluated and are shown to represent one dimensional relative diffusion among the adiabatic variables, independent of the representation (e.g., whether diffusion is measured relative to mass, or toroidal flux, or poloidal flux). The skin effect diffusion coefficient decouples from the other coefficient and represents diffusion of one magnetic field component relative to the other. Other transport coefficients such as those for mass and energy flow are intrinsically coupled. DOE

N81-11857# General Atomic Co., San Diego, Calif.
PROPERTIES OF DIVERTED PLASMAS WITH MAGNETICALLY EXPANDED FLUX SURFACES
Mahdavi M. Ali, N. Ohyabu, D. R. Baker, N. H. Brooks, J. C. Deboo, S. E. Ejima, R. T. Groebner, G. L. Jahns, J. L. Luxon, and F. B. Marcus Jul. 1980 13 p refs Presented at the 8th Intern. Conf. on Plasma Phys. and Controlled Nucl. Fission Res., Brussels, 1-10 Jul. 1980 Submitted for publication
(Contract DE-AT03-76ET-51011)
(GA-A-15963; IAEA-CN-38/PD; CONF-800707-18) Avail: NTIS HC A02/MF A01

Vertical elongated 1.3:1 elliptical plasmas in which the outermost flux surfaces are magnetically expanded and diverted by external coils into the lower half of the Doublet 3 vacuum vessel are described. Approximately 5 cm of the nominal 45 cm plasma minor radius is diverted to the lower chamber. The diverted flux is expanded by more than a factor of ten before reaching the vessel wall. Photographic measurements show diffused hydrogen recycling light in the lower half of the vessel, with greatly reduced recycling at the normal limiters, and no evidence of localized particle flow to the vessel wall. A significant amount (approximately 50 percent) of the ohmic power is radiated in the expanded boundary region.Comparison of similar low density plasmas with and without the expanded boundary shows that the expanded boundary reduces the influx of nickel and oxygen impurities. DOE

N81-11858# Wisconsin Univ. - Madison.
DIVERTOR EXPERIMENTS IN A TOROIDAL PLASMA WITH E x B DRIFT DUE TO AN APPLIED RADIAL ELECTRIC FIELD
E. J. Strait Sep. 1979 243 p refs
(Contract DE-AS02-76ET-53051)
(COO-2387-117) Avail: NTIS HC A11/MF A01

It is proposed that the E x B drift arising from an externally applied electric field could be used in a Tokamak or other toroidal magnetic plasma confinement device to remove plasma and impurities from the region near the wall and reduce the amount of plasma striking the wall. This could either augment or replace a conventional magnetic field divertor. Among the possible advantages of this scheme are easy external control over the rate of removal of plasma, more rapid removal than the naturally occurring rate in a magnetic divertor, and simplification of construction if the magnetic divertor is eliminated. Results of several related experiments performed in a levitated octupole are presented. DOE

N81-11859# Wisconsin Univ. - Madison.
AXISYMMETRIC INSTABILITY IN A NONCIRCULAR TOKAMAK Ph.D. Thesis
B. Lipschultz Oct. 1979 114 p refs
(Contract DE-AS02-76ET-53051)
(COO-2387-118) Avail: NTIS HC A06/MF A01

The stability of dee, inverse dee, and square cross section plasmas to axisymmetric modes were investigated experimentally in Tokapole II, a Tokamak with a four null poloidal divertor. Experimental results are closely compared with predictions of two numerical stability codes - the PEST code (ideal MHD, linear stability) adapted to tokapole geometry and a code which follows the nonlinear evolution of shapes similar to tokapole equilibria. DOE

N81-11860# Texas Univ. at Austin.
NONADIABATIC EFFECTS OF FIELD RIPPLE ON ENERGETIC IONS IN TOKAMAKS
F. L. Hinton Jun. 1980 50 p refs
(Contract DE-AC05-76ET-53036)
(DOE/ET-53036/17; FRCR-212) Avail: NTIS HC A03/MF A01

Some effects of toroidal field ripple on energetic ion orbits in Tokamaks are considered. A finite gyroradius generalization of the adiabatic orbit theory condition for ripple trapping is derived. Resonances between the cyclotron motion and the motion through the field ripple are discussed. Conditions on the magnitude of the field ripple and the gyroradius are derived such that the phase space islands corresponding to the cyclotron resonances overlap the ripple trapping region. The intrinsic orbit stochasticity resulting from island overlap may be described as pitch angle scattering. The diffusion coefficient is obtained from a mapping which is derived from the equations of motion. After scattering into the ripple trapping region of phase space, particles are lost due to guiding center drifts in the toroidal field. Applications to ions in reactor size tokamaks are discussed. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.

N81-11861 Stanford Univ., Calif.
THE ANALYSIS OF DISLOCATION, CRACK, AND INCLUSION PROBLEMS IN PIEZOELECTRIC SOLIDS Ph.D. Thesis
Wolfgang Friedrich Johann Deeg 1980 214 p
Avail: Univ. Microfilms Order No. 8024638

Stress analysis of defects in piezoelectric materials is discussed. After a short literature review, the basic equations of piezoelectric elasticity are presented. These equations are a generalized form of Hooke's Law, the equilibrium equations, and the definition of the free energy potential for a piezoelectric solid. A short-hand notation is introduced by combining stress and electric displacement in a 3 x 4 matrix, elastic displacement

and electric potential in a four component column vector, and by defining an electro-elastic constant matrix. When using this short hand notation, the basic equations of piezoelectric elasticity take on a form very similar to that of the analogous equations encountered in anisotropic elasticity theory. This similarity is used to analyze various problems of interest in any basic elasticity theory. Dissert. Abstr.

N81-11862 Minnesota Univ., Minneapolis.
EFFECTS OF SPIN-FLIP SCATTERING ON THE DYNAMICS OF THE SUPERCONDUCTING ORDER PARAMETER Ph.D. Thesis
Frank Eugene Aspen 1980 178 p
Avail: Univ. Microfilms Order No. 8025414

Measurements of the imaginary part of the pair field susceptibility chi carried out on dirty limit Al-Er alloy films are discussed. Aluminum films with erbium concentrations of up to one atomic percent were incorporated as the low T sub c film of an asymmetric Josephson junction. The excess current I sub ex due to pair tunneling was measured as a function of the bias voltage V and of the magnetic field H, applied in the plane of the junction, at temperatures within 20% of the critical temperature. Comparison to theory was facilitated by noting that chi (omega,k) varies as I sub ex (V,H) where the frequency omega and wave number k are related to V and H via the Josephson relations. The experiments represent the measurements of chi (omega,k) as a function of the pair breaking parameter rho up to 0.1. At temperatures above T sub c it was verified that the diffusive time dependent Ginzburg-Landau equation for order parameter fluctuations is valid in the presence of pair breaking. The diffusion rate was found to be reduced by the pair breaking to a value which is in quantitative agreement with theory. Additional results are detailed. Dissert. Abstr.

N81-11863 George Washington Univ., Washington, D.C.
TWO-DIMENSIONAL THEORETICAL MODEL FOR THE ION-IMPLANTED DEPLETION-MODE MOSFET IN CURRENT SATURATION Ph.D. Thesis
John Thomas Hall 1980 189 p
Avail: Univ. Microfilms Order No. 8021655

A two section transistor model is considered for the depletion mode transistor in saturation. A general gradual channel model is developed for the source section, taking into account the Q sub ss charge, built-in voltage across the substrate channel junction, and the dependence on backgate voltage. The drain section is represented by Green's function expansions in the oxide and channel areas. The channel area potential is derived for the totally depleted fixed charge uniformly distributed over the area. The substrate is represented by a one dimensional expansion with a power series expansion for the depletion layer. The internal boundary coefficients are evaluated in terms of the power series coefficients by matching boundary conditions throughout. A parabolic distribution for the substrate depletion region is assumed. A set of simultaneous nonlinear equations is developed. A charge equation is developed to represent the mobile charge injected into the depleted channel. The technique gives a first order estimate to the diffusion current as well. A long- and a short-gate configuration are compared. Dissert. Abstr.

N81-11864 Brandeis Univ., Waltham, Mass.
TWO PROBLEMS IN DISORDERED FERROMAGNETISM Ph.D. Thesis
Joel David Schwartz 1980 115 p
Avail: Univ. Microfilms Order No. 8024543

The low temperature properties of semiinfinite and compositionally disordered ferromagnets were studied within the framework of the spin wave model Hamiltonian. In the surface problem the perfect crystal is considered to be cleaved, creating a layer of atoms with neighbors to one side, but not the other. The changes in the magnetic spectrum, density of states, and magnetization induced by this cleavage were studied in a ferromagnetic insulator. Both a reduction of the ferromagnetic coupling between surface and bulk, and also the possibility of a surface layer antiferromagnetically bonded to the remainder of the crystal were explored. The random nature of a binary alloy of ferromagnetic materials destroys the crystalline symmetry of the potential. In the spin wave approximation to the Heisenberg Hamiltonian, the off-diagonal terms in the Hamiltonian are of the same order of magnitude as the diagonal ones. In the simplest models, they are identical. This necessitates the introduction of off-diagonal disorder into the coherent potential approximation. Dissert. Abstr.

N81-11865 Kansas Univ., Lawrence.
LATTICE STATICS AND DYNAMICS OF FREE MAGNESIUM-OXIDE SURFACES Ph.D. Thesis
Robert Neal Barnett 1980 202 p
Avail: Univ. Microfilms Order No. 8026660

A bulk lattice dynamical model, the central force breathing shell model, is adapted to describe the interionic interactions in the surface region of a finite crystal. An exact solution is obtained for the model lattice statics, and the lattice dynamics problem is treated in the harmonic approximation. Surface thermodynamic properties and vibrational correlation functions for ions in the surface region are also discussed. The surface excess frequency distribution functions are compared to an experimental particle excess function, and some improvement results from the relaxation. However, the features of the model function are about four times smaller than those of the experimental function. Surface thermodynamic functions are also in qualitative agreement with experimental results, but the same sort of discrepancy in scale occurs. Vibrational correlation functions are found to be enhanced in the surface region, and the enhancement is increased by the relaxation. Tables of vibrational correlation functions are included. Dissert. Abstr.

N81-11866*# Pennsylvania State Univ., University Park.
OBLIQUE-INCIDENCE SECONDARY EMISSION FROM CHARGED DIELECTRICS
James W. Robinson and Paul A. Budd 1980 16 p refs
(Grant NsG-3166)
(NASA-CR-163714) Avail: NTIS HC A02/MF A01 CSCL 20L

Secondary electron emission coefficients were measured on FEP-Teflon for normal and oblique incidence in the presence of a normal electric field. Such measurements require knowledge of the electrostatic environment surrounding the specimen, and they require calculation of particle trajectories such that particle impact parameters can be known. A simulation using a conformal mapping, a Green's integral, and a trajectory generator provides the necessary mathematical support for the measurements, which were made with normal fields of 1.5 and 2.7 kV/mm. When incidence is normal and energy exceeds the critical energy, the coefficient is given by (V sub 0/V) to the .58 power, and for oblique incidence this expression may be divided by the cosine of the angle. The parameter V sub 0 is a function of normal field. Author

N81-11867# IBM Watson Research Center, Yorktown Heights, N.Y.
THEORETICAL STUDIES OF DEFECTS IN TETRAHEDRAL SEMICONDUCTORS Final Technical Report, 15 Jun. 1979 - 14 Jun. 1980
Sokrates T. Pantelides and James A. VanVechten Aug. 1980 135 p refs
(AD-A089938; AFOSR-80-0758TR) Avail: NTIS HC A07/MF A01 CSCL 20/12

This is the final report on work that has been carried out on the electronic and thermochemical properties of impurities, point defects and dislocations in semiconductors. GRA

N81-11868# Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon Systems Lab.
DIELECTRIC CONSTANT MEASUREMENTS ON LEAD AZIDE SINGLE CRYSTALS
W. L. Garrett and P. J. Kemmey Sep. 1980 14 p refs
(AD-A089987; AD-E400469; ARLCO-TR-80023) Avail: NTIS HC A02/MF A01 CSCL 19/1

The dielectric constants of lead azide in single crystal form were measured in the three crystallographic directions and found to be unusually large and highly anisotropic. The dielectric constants are fairly independent of temperature over the range of 100 K to 370 K and of frequency over the range of 100 to 1000 Hz. The dielectric constants of the azides of T1, Na, and K were also measured and compared to published values. Calculations taking into account the crystal structure of lead

azide indicate that the observed anistropy arises from polarization of the azide molecules. GRA

N81-11869# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
SOLID STATE EXTRUSION OF MELT-CRYSTALLIZED AND SOLUTION-GROWN CRYSTALS OF NYLONS 6 AND 66 Interim Technical Report
Toshio Shimada and Roger S. Porter 15 Jul. 1980 31 p refs
(Contract N00014-75-C-0686)
(AD-A090015; TR-14) Avail: NTIS HC A03/MF A01 CSCL 13/8

Melt and solution grown crystals of nylons 6 and 66 have been solid state extruded to examine the relationships among thermal behavior, crystallinity, orientation and modulus. Unextruded and extruded samples were examined by thermal analysis, wide angle x-ray and by tensile testing. An extrusion draw ratio (EDR) of 4.0 was attained for all samples. At this EDR, modulus and crystallinity are linearly related over a wide range up to 60% crystallinity. The highest tensile modulus of 6.7 GPa was attained for both polymers in estrudates of solution-grown crystals, although these extrudates of compacted precipitates were less oriented. This suggests that the extent of both crystallinity and draw play an important role in the enhancement of modulus. GRA

N81-11870# Stanford Univ., Calif. Electronics Labs.
STUDY OF THE ELECTRONIC SURFACE STATES OF 3-5 COMPOUNDS Semiannual Technical Progress Report, 1 Oct. 1979 - 31 Mar. 1980
W. E. Spicer and I. Lindau 1980 109 p refs
(Contract N00014-79-C-0072; ARPA Order 3564)
(AD-A090193) Avail: NTIS HC A06/MF A01 CSCL 20/12

At the time of the last semiannual report, we had stated the development of the unified defect model for Schottky-barrier formation. Since then, work has proceeded to further explain the nature and the source of states at the oxide: 3-5 interface and metal semiconductor interface. This is of crucial importance to the MOS technology. Along with the extension in scope of the unified defect model, more work to establish the model on a more refined and definitive basis has been carried out. Making use of the techniques we have developed, we started studying on an atomic scale the bonding trends of column 3 and 5 elements on GaAs. This work is not only important to the understanding of the metal-semiconductor interface but also has very significant bearing on the crystal growth mechanism. For oxygen adsorption, we have studied in detail both the nature of Fermi-level pinning at very low oxygen coverage and surface chemistry near monolayer coverage. Work on metal-Si interaction has also been greatly advanced in the past six months. Analysis of prior results of Au on Si has been completed. Experiments of Pd on Si have been conducted and results have been analyzed. GRA

N81-11871# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
EFFECTS OF SPIN-FLIP SCATTERING ON THE DYNAMICS OF THE SUPERCONDUCTING ORDER PARAMETER Ph.D. Thesis
Frank Eugene Aspen Jun. 1980 179 p refs
(Contract DE-AS02-76ER-01569)
(DOE/ER-01569/149) Avail: NTIS HC A09/MF A01

The pair field susceptibility X in. was measured on dirty limit Al-Er alloy films. Aluminum films with erbium concentrations of up to one atomic percent were incorporated as the low T/sub c/ film of an asymmetric Josephson junction. The excess current I/sub ex/ due to pair tunneling was measured as a function of the bias voltage V and of the magnetic field H, applied in the plane of the junction, at temperatures within 20% of the critical temperature T/sub c/. Comparison to theory was facilitated by noting that X in. (omega,k) varies as I sub ex/(V,H) where the frequency omega and wave number k are related to V and H via the Josephson relations. DOE

N81-11872# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH, 1980: 1 Quarterly Technical Summary Report, 1 Nov. 1979 - 31 Jan. 1980
Alan L. McWhorter 15 Feb. 1980 68 p refs
(Contract F19628-80-C-0002; AF Proj. 649L)
(AD-A089822; ESD-TR-79-325) Avail: NTIS HC A04/MF A01 CSCL 05/1

This report covers in detail the solid state research work of the Solid State Division at Lincoln Laboratory for the period 1 November 1979 through 31 January 1980. The topics covered are solid state device research, quantum electronics, materials research, is primarily provided by the Air Force, with additional support provided by the Army, DARPA, Navy, NASA, NSF, and DOE. GRA

N81-11873# Xerox Palo Alto Research Center, Calif.
STRUCTURAL AND ELECTRONIC STUDIES OF DEFECTS IN AMORPHOUS SILICON Technical Progress Report, Mar. - May 1980
R. A. Street 15 Jul. 1980 45 p refs
(Contract DE-AC02-77CH-00178)
(SERI/PR-9079-1-T1; TPR-1) Avail: NTIS HC A03/MF A01

Proton magnetic resonance data are presented for plasma-deposited amorphous Si:H as a function of annealing temperature up to 650 C. The data indicate that hydrogen diffuses internally before major evolution occurs, that transfer of hydrogen occurs from a heavily clustered phase to a dilute phase coincident with evolution and that evolution occurs initially from the heavily clustered phase. Comparison with infrared data indicates that the heavily clustered phase can be either SiH/ sub x/t = 2,3 2,3 or SiH. DOE

N81-11874# Sandia Labs., Albuquerque, N. Mex.
THERMAL ACCOMMODATION COEFFICIENT OF HELIUM AND ARGON ON AN AMORPHOUS SiO2 SURFACE
Alan McFall 1980 22 p refs Presented at the 12th Intern. Symp. on Rarefied Gas Dyn., Charlottesville, Va., 7 Jul. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-0298C; CONF-800715-2) Avail: NTIS HC A02/MF A01

The thermal accommodation coefficient was determined for the interaction of two inert gases, helium and argon, on a surface composed of thermally grown amorphous silicon dioxide. The surface was processed as an integrated circuit chip and utilized components capable of generating heat and measuring temperature. The accommodation coefficient of helium on clean SiO2 was found to be 0.198, while that for argon was 0.421. Both one dimensional and three dimensional continuum theory models of the accommodation coefficient were used for comparison with the experimental data. DOE

N81-11875# Texas A&M Univ., College Station.
TRANSITION METAL-GRAPHITE CATALYSIS SUPERCONDUCTORS Ph.D. Thesis
Daniel Wayne Rosynek May 1978 154 p refs
(Contract W-7405-eng-82)
(DOE/ET/10673-T1) Avail: NTIS HC A08/MF A01

Theoretical descriptions of the upper critical fields in reentrant and anisotropic superconductors are presented. The theories are essentially microscopic in nature and incorporate many of the effects known to influence the behavior of superconducting electrons. In cases where adequate experimental data exist, the agreement between experiment and theory is found to be good. DOE

N81-11876# Ames Lab., Iowa. Physics Dept.
SUPERCONDUCTING TUNNELING STUDY OF V AND V3Ga Ph.D. Thesis
John Francis Zasadzinski Aug. 1980 110 p refs
(Contract W-7405-eng-82)
(IS-T-904) Avail: NTIS HC A06/MF A01

The technique of proximity effect tunneling spectroscopy (PETS) was applied to the transition metal, vanadium, and to the A-15 compound V3Ga. The method employs the deposition of a thin layer (< or = 100 A) of Al in ultra high vacuum to form proximity junctions of the form C-Al2)3-Al/S. Here S is the superconductor of interest and C is the convenient counter-electrode. The experimental techniques are described and the underlying theory and methods of analysis are discussed. Results include the energy dependent pair potential, delta/sub S/(E), the renormalization function Z/sub S/(E), Eliashberg function sq

alpha F(omega), electron phonon coupling constant lambda and Coulomb pseudopotential mu* DOE

N81-11877# Ames Lab., Iowa.
UPPER CRITICAL FIELD IN ANISOTROPIC SUPERCONDUCTORS Ph.D. Thesis
Daniel Wayne Younger Aug. 1980 154 p refs
(Contract W-7405-eng-82)
(IS-T-901) Avail: NTIS HC A08/MF A01

Theoretical descriptions of the upper critical fields in reentrant and anisotropic superconductors are presented. The theories are essentially microscopic in nature and incorporate many of the effects known to influence the behavior of superconducting electrons. In cases where adequate experimental data exist, the agreement between experiment and theory is found to be good. DOE

N81-11878# Los Alamos Scientific Lab., N. Mex. Theoretical Div.
CALCULABILITY OF THE N-P MASS DIFFERENCE IN GAUGE THEORIES
Joe Kiskis 1980 7 p refs Presented at the 20th Intern. Conf. on High Energy Phys., Madison, Wisc., 17-23 Jul. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2450; CONF-800724-13) Avail: NTIS HC A02/MF A01

The requirement of a calculable n-p mass difference lead to a consideration of unified gauge theories. Grand unified models provide a realistic framework for the calculation of the n-p mass difference. The possibility that the relatively soft ultraviolet behavior of QCD softens the divergence in the lowest order electromagnetic mass shift was considered in detail. If the bare mass and QCD coupling are constrained to be independent of the electromagnetic coupling as is natural, then the lower order electromagnetic shifts of the renormalized mass and QCD coupling are infinite. DOE

N81-11879# Oak Ridge National Lab., Tenn.
MICRODIFFRACTION FROM CRYSTALS CONTAINING DEFECTS
R. W. Carpenter 1980 17 p refs Presented at the Ann. Meeting of the Electron Microscopy Soc. of Am. and the 15th Microbeam Analysis Soc. Conf., San Francisco, 4 Aug. 1980
(Contract W-7405-eng-26)
(CONF-800801-8) Avail: NTIS HC A02/MF A01

In order to examine defects in crystals using electron diffraction it is desirable to irradiate only the local crystal region containing the defect. Recent improvements in microscope instrumentation, principally in the areas of electron optics and vacuum systems, have made convergent beam electron diffraction of a relatively simple experimental method, and it is the method of choice for diffraction investigation of many types of lattice defects. Although the method has been used in crystal physics research for about 40 years, only recently have applications to materials science problems begun. At present, applications of the method are being made to characterization of grain and interphase boundaries, local foil thickness measurement, lattice defect symmetry characterization, small precipitate crystallography, and other problems at various laboratories. The method is described, its use for Burgers vector direction determination is illustrated, and use of convergent beam shadow images is discussed. DOE

N81-11880# Argonne National Lab., Ill.
NONELASTIC-SCATTERING CROSS SECTION OF ELEMENTAL NICKEL
A. B. Smith, P. T. Guenther, and J. F. Whalew Jun. 1980 24 p refs
(Contract W-31-109-eng-38)
(ANL/NDM-54) Avail: NTIS HC A02/MF A01

Neutron total cross sections of elemental nickel were measured from 1.3 to 4.5 MeV, at intervals of approximately 50 keV, with resolutions of 30 to 50 keV and to accuracies of 2.5%. Neutron differential elastic scattering cross sections were measured from 1.45 to 3.8 MeV, at intervals and with resolutions comparable to those of the total cross sections, and to accuracies of 3 to 5%. The nonelastic scattering cross section is derived from the measured values to accuracies of > 6%. The experimental results are compared with previously reported values as represented by ENDF/B-V, and areas of consistency and discrepancy, noted. The measured results are shown to be in good agreement with the predictions of a model previously reported by the authors. DOE

N81-11881# National Bureau of Standards, Washington, D.C. Surface Science Div.
STRUCTURES OF ADSORBED CO ON ATOMICALLY SMOOTH AND ON STEPPED SINGLE CRYSTAL SURFACES
Theodore E. Madey and Jack E. Houston 1980 20 p refs Presented at the 6th Intern. Conf., on Crystal Growth, Moscow, Sep. 1980 Supported in part by ONR
(Contract DE-AC04-76DP-00789)
(SAND-80-1038C; CONF-800908-1) Avail: NTIS HC A02/MF A01

The electron simulated desorption ion angular distribution (ESDIAD) method was used to study the structures of molecular CO adsorbed on atomically smooth surfaces and on surfaces containing monatomic steps. For CO adsorbed on the closepacked Ru(001) and W(110) surfaces, the dominant bonding mode is via the carbon atom, with the CO molecular axis perpendicular to the plane of the surface. For CO on atomically rough Pd(210), and for CO adsorbed at step sites on four different surfaces vicinal to W(110), the axis of the molecule is tilted or inclined away from the normal to the surface. The ESDIAD method, in which ion desorption angles are related to surface bond angles, provides a direct determination of the structures of adsorbed molecules and molecular complexes on surfaces. DOE

N81-11882# Los Alamos Scientific Lab., N. Mex.
EXPLOSIVE GENERATION OF HIGH MAGNETIC FIELDS IN LARGE VOLUMES AND SOLID STATE APPLICATIONS
C. M. Fowler, R. S. Caird, D. J. Erickson, B. L. Freeman, and W. B. Garn 1980 11 p refs Presented at OJI Intern. Seminar on the Appl. of High Magnetic Fields in Phys. and Semiconductors and Magnetic Mater., Hakone, Japan, 10-13 Sep. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2182; CONF-800936-1) Avail: NTIS HC A02/MF A01

Various methods of producing ultrahigh magnetic fields by explosive flux compression are described. A survey was made of the kinds of high magnetic field solid state data obtained in such fields by various groups. Preliminary results are given for the magnetic phase boundary that separates the spin flop and paramagnetic regions of MnF2. DOE

N81-11883# Los Alamos Scientific Lab., N. Mex.
MUON SPIN DEPOLARIZATION IN NONMAGNETIC METALS DOPED WITH PARAMAGNETIC IMPURITIES
R. H. Heffner 1980 9 p refs Presented at the 2d Intern. Topical Meeting on Muon Spin Rotation Vancouver, British Columbia, Aug. 1980 Submitted for publication
(Contract W-7405-eng-36)
(LA-UR-80-2375; CONF-800855) Avail: NTIS HC A02/MF A01

The diffusion of muons and their magnetic interactions are treated by describing the physics to be learned from experiments which measure muon depolarization in metallic hosts doped with dilute concentrations of magnetic impurities. DOE

N81-11884# Los Alamos Scientific Lab., N. Mex.
DEPOLARIZATION OF DIFFUSING SPINS BY PARAMAGNETIC IMPURITIES
M. E. Schillaci, R. L. Hutson, R. H. Heffner, M. Leon, S. A. Dodds, and T. L. Estle 1980 5 p refs Presented at 2d Intern. Topical Meeting on Muon Spin Rotation, Vancouver, Canada, Aug. 1980 Sponsored in part by NSF Prepared in cooperation with Rice Univ., Houston, Tex.
(Contract W-7405-eng-36)
(LA-UR-80-2376; CONF-800855-4) Avail: NTIS HC A02/MF A01

The depolarization of diffusing spins (muons) interacting with dilute paramagnetic impurities in a solid was studied using a simple computational model which properly treats the muon motion and preserves correct muon-impurity distances. Long range (dipolar) and nearest neighbor (contact) interactions are

treated together. Diffusion parameters are deduced and model comparisons made for AuGd (300 ppM). DOE

N81-11885# Ames Lab., Iowa.
FOUR: A GENERAL CRYSTALLOGRAPHIC FOURIER PROGRAM
Douglas R. Powell and Robert A. Jacobson May 1980 37 p refs
(Contract W-7405-eng-82)
(IS-4737) Avail: NTIS HC A03/MF A01

FOUR computes two and three dimensional Patterson and electron density maps for crystallographic data with any space group symmetry. The program utilizes regular Fourier techniques for the summations in sections and down a given page. The final summation across the page is computed by use of a fast Fourier transform algorithm. A detailed description of the program together with the symbolic program listing is supplied. DOE

N81-11886# Bendix Corp., Kansas City, Mo.
SEMICONDUCTOR CHIP PROCESSING Final Report
A. V. Grimm Jul. 1980 10 p
(Contract DE-AC04-76DP-00613)
(BDX-613-2466) Avail: NTIS HC A02/MF A01

The processes necessary to assemble metal oxide semiconductor devices in hermetic ceramic packages were developed. The assembly techniques developed were gold silicon die attachment, 25.4 micron aluminum wire interconnection, and gold tin cover attachment. DOE

N81-11887# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
FLUCTUATION ANALYSIS
John Clarke 1980 20 p refs Presented at Intern. Conf. on Superconducting Quantum Interference Devices, Berlin, 5-9 May 1980
(Contract W-7405-eng-48)
(LBL-11055; CONF-8005104-1) Avail: NTIS HC A02/MF A01

Sources of noise in Josephson junctions, and the limits they impose on the sensitivity of dc and RF SQUIDS are reviewed. The results are strictly valid only for a resistively shunted junction (RSJ) with zero capacitance, but should be applicable to point contact junctions and microbridges in so far as these devices can be approximated by the RSJ model. Fluctuations arising from Nyquist noise in the resistive shunt of a single junction are discussed in the limit el/sub o/R/k/sub B/T < < 1 in which a classical treatment is appropriate, and then the treatment is extended to the limit el/sub o/R/k/sub B/T > or = 1 in which quantum effects become important. The Nyquist limit theory is used to calculate the noise in a dc SQUID, and the results are compared with a number of practical devices. Results for the predicted sensitivity of RF SQUIDS are presented, and also compared with a number of practical devices. The importance of l/f noise (f is the frequency) in limiting the low frequency performance of SQUIDS is discussed. DOE

N81-11888# California Univ., Berkeley. Materials and Molecular Research Div.
NORMAL EMISSION PHOTOELECTRON DIFFRACTION: A NEW TECHNIQUE FOR DETERMINING SURFACE STRUCTURE Ph.D. Thesis
Stephen D. Kevan May 1980 177 p ref
(Contract W-7405-eng-48)
(LBL-11017) Avail: NTIS HC A09/MF A01

Photoelectron diffraction is characterized. The differential (angle resolved) photoemission cross section of a core level localized on an adsorbate atom is measured as a function of some final state parameter. The photoemission fuel state consists of two components, one of which propagates directly to the detector and another which scatters off the surface and then propagates to the detector. These are added coherently, and interference between the two manifests itself as cross section oscillations which are sensitive to the local structure around the absorbing atom. These deal effectively with two and probably also three dimensionally disordered systems. DOE

N81-11889# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
EXPERIMENTAL STUDIES IN SOLID STATE AND LOW TEMPERATURE PHYSICS Final Report, 1 Jan. 1966 - 30 Jun. 1980
A. M. Goldman, W. V. Weyhmann, and W. Zimmermann, Jr. Jun. 1980 31 p refs
(Contract DE-AS02-76ER-01569)
(DOE/ER-01569/147) Avail: NTIS HC A03/MF A01

Experimental and theoretical investigations were carried out in a broad area of low temperature and solid state physics which includes superconductivity, theory of quantum crystals, magnetism in metals, and liquid helium. Investigations of the Josephson effect, studies of the pair field susceptibility of superconductors and investigations of the thermodynamics of the superconducting phase transition are discussed. The competion between the metal-nonmetal transition and superconductivity was studied in random metal-rare gas systems. In the area of magnetism, magnetically ordered materials and dilute magnetic alloys were investigated. DOE

N81-11890# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
ELECTRICAL ANALOG OF A JOSEPHSON JUNCTION
A. M. Goldman 1979 13 p refs
(Contract DE-AS02-76ER-01569)
(DOE/ER-01569/146) Avail: NTIS HC A02/MF A01

A mathematical description of the phase coupling of two oscillators synchronized by a phase lock loop under the influence of thermal white noise is analogous to that of the phase coupling of two superconductors in a Josephson junction also under the influence of noise. This analogy may be useful in studying threshold instabilities of the Josephson junction in regimes not restricted to the case of large damping. The behavior of the mean voltage near the threshold current can be charactarized by critical exponents which resemble those exhibited by an order parameter of a continuous phase transition. It is possible to couple a collection of oscillators together in a chain, the oscillator analogy may also be useful in exploring the dynamics and statistical mechanics of coupled junctions. DOE

N81-11891# Rice Univ., Houston, Tex. Dept. of Physics.
REVIEW OF THE EXPERIMENTAL RESULTS ON IMPURITY CENTERS IN ELEMENTAL SEMICONDUCTORS OBTAINED BY MUSR
T. L. Estle Los Alamos, N. Mex. LASL 1980 9 p refs Presented at 2d Intern. Topical Meeting on Muon Spin Rotation, Vancouver, British Columbia, Aug. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2377; CONF-800855-3) Avail: NTIS HC A02/MF A01

Selected electron paramagnetic resonance studies of defect centers in group 4 semiconductors are reviewed. Features of this research which are useful in analyzing the nature of normal and anomalous muonium (Mu and Mu star) in these crystals are pointed out, and a moderately specific model of Mu and Mu star is presented and compared to studies of hydrogen in silicon and germanium. DOE

N81-11892# Rice Univ., Houston, Tex.
TEMPERATURE DEPENDENCE OF ANOMALOUS MUONIUM HYPERFINE INTERACTIONS IN SILICON
K. W. Blazey, J. A. Brown (LASL, N. Mex.), D. W. Cooke (Memphis State Univ., Tenn.), S. A. Dodds (LASL, N. Mex.), T. L. Estle (LASL, N. Mex.), R. H. Heffner, M. Leon, and D. A. Vanderwater 1980 5 p refs Presented at 2d Intern. Topical Meeting on Muon Spin Rotation, Vancouver, British Columbia, Aug. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2373; CONF-800855-6) Avail: NTIS HC A02/MF A01

The temperature dependence of the anomalous muonium hyperfine interaction was measured in silicon. Between 5 and 150 K, an approximately 1% decrease was observed and attributed to interaction with the silicon host phonons. DOE

N81-11893# Brookhaven National Lab., Upton, N. Y. Physics Dept.
POSITIVE MUON AND THE POSITRON AS PROBES OF DEFECTS
K. G. Lynn 1980 14 p refs Presented at the 2d Intern.

Topical Meeting on Muon Spin Rotation, Vancouver, British Columbia, Aug. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28196; CONF-800855-9) Avail: NTIS HC A02/MF A01

The positive muon and the positron are each used to investigate defects in condensed matter. The experimental methods employed with each particle are summarized. Similarities and differences between the behavior of the two leptons when implanted in condensed matter are pointed out, and by means of a comparison between muon and positron data in Al it was shown that the combination of muon and positron experiments can serve as a useful probe of defects in solids. DOE

N81-11894# Los Alamos Scientific Lab., N. Mex.
LASL Nb3Ge CONDUCTOR DEVELOPMENT Quarterly Progress Report, 1 Jan. - 31 Mar. 1980
M. P. Maley, comp. 1980 17 p refs
(Contract W-7405-eng-36)
(LA-8446-PR; QPR-15) Avail: NTIS HC A02/MF A01

The development of Nb3Ge as a superconductor with potential applications to power transmission lines is discussed. Three Nb3(Ge sub 1-x Ga/sub x) pseudobinary compounds were prepared with compositions approaching the proper stoichiometry and with x = 0.08, 0.12, and 0.15, respectively. The replacement of germanium by gallium causes a slight depression (1.0 K) of T sub c and does not appear to influence H sub c2 significantly. A microscopic examination of the edge material on sections of Nb3Ge-clad tape revealed longitudinal cracks extending along the edges of tapes with Nb3Ge thickness T > or = 4.0 microns. Tapes with t = 3.0 microns show no evidence of such cracks, corroborating conclusions reached by ac loss measurements. The two layers of the inner conductor of the first 1-m test cable were wound with tapes coated with 4 to 6 microns of Nb3Ge and are expected to contain longitudinal cracks. The two layers of the outer conductor of this coaxial cable were fabricated from tapes coated with 3.0 microns of Nb3Ge and should exhibit lower ac losses. DOE

N81-11895 American Univ., Washington, D. C.
APPLICATION OF PSEUDOPOTENTIALS TO SODIUM PALLADIUM ALLOYS Ph.D. Thesis
Joseph Douglas White 1980 125 p
Avail: Univ. Microfilms Order No. 8023844

The use of highly sensitive servo techniques allows precise measurements of the speed of sound in dilute Na-Pd alloys. Comparisons of the speed of sound in the alloy and pure metal yield the solubility which in turn is used to derive the excess entropy and enthalpy of mixing. The effect of speed of sound due to small amounts of palladium up to the saturation level is given. These data are compared to predictions based on a first principles calculation. Calculated properties include the hard sphere diameter, the change in the speed of sound, the enthalpy of mixing and the entropy of mixing. Dissert. Abstr.

N81-11985*# Alabama Univ. in Huntsville. Dept. of Mathematics.
MATERIAL AND PROCESS CONSTRAINTS FOR A FLAT INTERFACE IN THE BRIDGMAN-STOCKBARGER TECHNIQUE
Larry M. Foster *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 21 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20L

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N81-11896# Fermi National Accelerator Lab., Batavia, Ill.
EXACT INTEGRABILITY IN QUANTUM FIELD THEORY
H. B. Thacker Aug. 1980 12 p refs Presented at the 5th Workshop on Current Probl. in High Energy Particle Theory, Bad Honnef, West Germany, 2-4 Jun. 1980
(Contract DE-AC02-76CH-03000)
(FERMILAB-CONF-80/69; CONF-800674-2) Avail: NTIS HC A02/MF A01

The treatment of exactly integrable systems in various branches of two dimensional classical and quantum physics was placed in a unified framework by the development of the quantum inverse method. This method consolidates a broad range of developments in classical nonlinear wave (soliton) physics, statistical mechanics, and quantum field theory. The essential technique for analyzing exactly integrable quantum systems was invested by Bethe. The quantum mechanical extension of the inverse scattering method and its relationship to the methods associated with Bethe's ansatz were examined. DOE

N81-11897# Brookhaven National Lab., Upton, N. Y. Physics Dept.
NEW IDEAS IN CALORIMETRY
H. A. Gordon, R. B. Palmer, and S. D. Smith 1980 24 p refs Presented at the Intern. Conf. on Exptn. at LEP, Uppsala, Sweden, 16-20 Jun. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28132; CONF-800684-4) Avail: NTIS HC A02/MF A01

The problem of operating calorimeters which use scintillators in a strong magnetic field is explored. Double wave shifting techniques were used to concentrate the light into a small area and then measuring it in place with solid state devices or microchannel plate photomultipliers or shipping the light remotely to normal phototubes via flexible light guides. Some novel schemes of casting plastic sheets with heavy metals for gas sampling calorimeters is also discussed. DOE

N81-11898# California Univ., Davis. Dept. of Applied Science.
ADIABATIC HAMILTONIAN DEFORMATION, LINEAR RESPONSE THEORY AND NONEQUILIBRIUM MOLECULAR DYNAMICS
W. G. Hoover 28 May 1980 9 p refs Presented at Sitges Intern. School and Symp. on Statistical Mech., Sitges, Spain, 9 Jun. 1980 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84455; CONF-800694-1) Avail: NTIS HC A02/MF A01

A nonequilibrium Hamiltonian formulation of fluid flow is described which provides pedagogically simple routes to nonequilibrium fluxes and distribution functions, to theoretical understanding of long time effects, and to new numerical methods for simulating systems far from equilibrium. The same methods applied to solid phase problems are also briefly discussed. At the relatively high frequencies used in the viscous fluid calculations described, solids typically behave elastically. Lower frequencies lead to the formation of dislocations and other defects, making it possible to study plastic flow. A property of the nonequilibrium equations of motion which might be profitably explored is their effective irreversibility. Because only a few particles are necessary to generate irreversible behavior, simulations using adiabatic deformations of the kind described could perhaps elucidate the instability in the equations of motion responsible for irreversibility. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N81-11899*# Hampton Roads Sanitation District, Virginia Beach, Va.
THE 1980 SUMMER RESEARCH FELLOWSHIP PROGRAM Final Report
Geraldine C. Darden, comp. Oct. 1980 31 p Program held in Hampton, Va., 2 Jun. - 8 Aug. 1980

(Contract NAS1-14832)
(NASA-CR-159369) Avail: NTIS HC A03/MF A01 CSCL 05A

The problem of incorporating visual input into robot systems is described. The photochemistry of the stratosphere, particularly possible permutations of the ozone layer, is discussed. Photoelectrochemical properties of metal thio-hypodiphosphates are investigated. Extreme eigenvalues are computed by the Lancqos approach. The rotational Raman spectra of the molecular atmosphere is studied. A computer operated mathematical symbolic manipulation system is described. Preparation of polycrystalline semiconductor electrodes of tungsten and molybdenum dichalcogenides is received. S.F.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N81-11900# California Univ., Berkeley. Operations Research Center.
PRODUCTION PLANNING FOR MULTI-RESOURCE NETWORK SYSTEMS
Robert C. Leachman Aug. 1980 16 p refs Submitted for publication
(Contract N00014-76-C-0134)
(AD-A089989; ORC-80-18) Avail: NTIS HC A02/MF A01 CSCL 12/2

Production planning for large-scale production systems requiring the allocation of numerous resources is considered. It is demonstrated how the dynamic activity analysis developed by Shephard leads to linear programming solutions of production planning problems. Three types of planning problems are formulated: maximization of output levels for a given time horizon; minimization of production duration for given output histories; and minimization of production costs for given output histories. GRA

N81-11901# California Univ., Berkeley. Operations Research Center.
MULTIPLE RESOURCE LEVELING IN CONSTRUCTION SYSTEMS THROUGH VARIATION OF ACTIVITY INTENSITIES Research Report
Robert C. Leachman Aug. 1980 19 p refs Submitted for publication
(Contract N00014-76-C-0134)
(AD-A089988; ORC-80-17) Avail: NTIS HC A02/MF A01 CSCL 05/1

The resource leveling problem for a construction system producing a stream of output units is considered. The system is modeled using a critical-path-analysis activity network from which an extended network is developed for an integrated planning effort of all output units. Activity intensity variables are defined which measure activity demand rates for resources and consequent activity durations for the production of each output unit. A heuristic approach consisting of an iterative non-linear programming procedure is presented which computes activity durations (intensities) for the minimization of resource capacity costs subject to meeting construction due dates. The application of a major ship overhaul is described in which the procedure was used to level workloads of the various labor-trade shops. GRA

N81-11902# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DESIGN TO COST AND LIFE CYCLE COST
Jul. 1980 333 p refs In ENGLISH and FRENCH Symp. held in Amsterdam, 19-22 May 1980
(AGARD-CP-289; ISBN-92-835-0268-X) Avail: NTIS HC A15/MF A01

Life cycle costs (LCC) methodology and its relation to specifications and requirements are discussed. Other topics include the impact of LCC analysis on total system design, cost control of operations and support, and LCC of subsystems and components. For individual titles, see N81-11903 through N81-11928.

N81-11903# British Aerospace Aircraft Group, Preston (England).
LIFE CYCLE COST ANALYSIS (LCCA) IN MILITARY AIRCRAFT PROCUREMENT
R. Chisholm *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 8 p refs (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The changing economic environment and the developing requirement to put increased emphasis on downstream activities in the early phases of a weapon system program are discussed. A possible approach to calculating the magnitude and spread of cost reducing investments is considered and applications of life cycle cost analysis in strategic decision making, the design process, and as a sales aid are mentioned. E.D.K.

N81-11904# Naval Air Systems Command, Washington, D. C.
O AND S COST VISIBILITY IN EARLY DESIGN
R. E. Houts *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 12 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Maintenance support costs and related cost data and techniques currently employed by the Naval Air Systems Command (NAVAIR) are discussed. The operating and support (O&S) cost definitions including the NAVAIR O&S cost breakdown structure, data bases, and cost estimating techniques that allow the analyst to employ engineering oriented cost analysis techniques in early design are presented. E.D.K.

N81-11905# Army Aviation Research and Development Command, St. Louis, Mo.
US ARMY DESIGN-TO-COST EXPERIENCE
Richard B. Lewis, II, Edward P. Laughlin, and Francis E. Spring *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 11 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Design-to-Cost procedures were included in all major U.S. Army aviation procurements since 1972. Experience was gained during design, development, procurement and initial fielding of several major systems. The ownership cost of this equipment is considered during development. Production and operational phases and techniques for cost control are discussed. Lessons learned as a result of joint Government-Industry Design-To-Unit-Production-Cost programs are presented. Techniques which were effective in cost management on utility and attack helicopters and turbine engine programs are listed. Producibility engineering planning, initial production tooling, and facilitization to reduce production costs are discussed. The role of warranties in controlling operating and support costs is illustrated. It is concluded that Design-To-Unit-Production-Cost techniques were effective in achieving lower production costs, but that additional work is necessary to better control operating and support costs and thereby achieve optimal life cycle costs. E.D.K.

N81-11906# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
A REVIEW AND ASSESSMENT OF SYSTEM COST REDUCTION ACTIVITIES
W. E. Lamar *In its* Design to Cost and Life Cycle Cost Jul. 1980 38 p refs (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

A review of the evolution of cost reduction concepts over the past decade to current design to life cycle cost (DTLCC) efforts is presented. Emphasis is given to progress achieved and basic problems and issues which have confronted successful application of these concepts. The review addresses the importance of top management action, consideration of costs in the early phase, and a credible data base. Progress in developing cost prediction and analysis methods, technologies to reduce development, acquisition, operations and support costs, the institutionalization of design to cost and design to life cycle cost methods, and remaining challenges are discussed. E.D.K.

N81-11907# Boeing Aerospace Co., Seattle, Wash.
DESIGN TO LIFE CYCLE COST RESEARCH
Fred T. Carlson *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 15 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Design to life cycle cost research applied to the area of logistics systems is discussed with a look at history data for typical aircraft systems. Deficiencies in systems operations and support are identified and described. Methods of assessing the cost, risk, and program application are discussed. Areas of emphasis, cost drivers, and their impacts are shown. It is determined that many deficiencies in the ownership of systems do not relate to program plans. Resolution by future technology advances must be aimed toward elimination of manpower, material, and program causative factors through research of logistics subsystems, i.e., inspections, material distribution, people use, and logistics networks. E.D.K.

N81-11908# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
IMPACT ON SYSTEM DESIGN OF COST ANALYSIS OF SPECIFICATIONS AND REQUIREMENTS
Horst Greiser *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 10 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Four categories of requirements are to be considered: (1) technical requirements; (2) operational requirements; (3) program-specific requirements; and (4) budget requirements. Their impact on cost is to be identified and quantified for each phase of a weapon system's life cycle. E.D.K.

N81-11909# British Aerospace Aircraft Group, Preston (England).
EVOLUTION OF TECHNIQUES FOR LCC ANALYSIS
J. M. Jones *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 13 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The need to control aircraft operating and support costs starting with a coordinated approach to life cycle cost (LCC) analysis during the conceptual design stage is identified. Experiences in the development and use of LCC models are discussed. The limitations of existing systems together with examples of current work on this subject are presented. E.D.K.

N81-11910# McDonnell Aircraft Co., St. Louis, Mo.
THE HORNET PROGRAM: A DESIGN TO LIFE CYCLE COST CASE STUDY
Robert D. Dighton *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 12 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

A primary requirement of the Hornet program is significant reduction in life cycle cost (LCC). The design and management techniques used to develop a new fighter/attack system at an affordable LCC are described. The designer must consider key elements of LCC such as reliability, maintainability, unit production cost, and logistics support cost elements in parallel with traditional concerns of weight and performance when designing life cycle costs. Examples of trade studies resulting in relatively large LCC avoidances are summarized. E.D.K.

N81-11911# General Dynamics/Fort Worth, Tex. F-16 Systems Engineering Management.
DESIGN TO COST AND THE F-16 MULTIROLE FIGHTER
W. M. Rowell *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 14 p refs (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The low cost of the F-16 Fighter Aircraft is the result of a selected balance of innovative technologies, available low cost material and equipment, and cost reducing configuration options. This was implemented through the application of design to cost concepts from the beginning of the program. The F-16 full scale development contract contained several clauses which provided downstream cost control including control of both acquisition and operations. A key part of this plan was the identification and close tracking of a few cost drivers which comprise over 50% of the air vehicle cost. A number of specific contract provisions are aimed at control of operating and support costs. These provisions provide financial incentives and penalties for consideration of reliability and other logistic support parameters. Other control provisions require cost considerations in trade studies, engineering change proposals, and in vendor selections. E.D.K.

N81-11912# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
STRUCTURAL INTEGRATION AS A MEANS OF COST REDUCTION
P. E. Siebert *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 17 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Through some components of the Tornado fighter aircraft it is demonstrated how costs can be reduced by structural integration. The components are two flat panels, the wing carry through box and the Taileron. Cost savings could be achieved from 15% to a maximum of 68%. E.D.K.

N81-11913# Avions Marcel Dassault, Saint-Cloud (France).
DESIGN-TO-COST AND NEW TECHNOLOGIES [DESIGN-TO-COST ET TECHNOLOGIES NOUVELLES]
Francois Cordie *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 8 p In FRENCH (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Modern combat aircraft design can no longer be undertaken without giving equal consideration to mission cost and performance when making compromises which lead to the choice of an aircraft formula. These compromises are based on technologies which can be used from the beginning of production. Usually they are new technologies which have passed the laboratory stage and applied to existing aircraft before being integrated into the design on a large scale. With respect to structures, carbon-epoxy composite technology is one of the most remarkable. Its introduction at the design stage results in reduction of mass and cost, first on the elements to which it is applied, and then by the amplifying effect on the assembly of the structure and the rest of the aircraft: engine, equipment, and fuel. Such a process supposes that the technology to be applied has attained a degree of maturation which permits prediction of performance and cost with certitude. Transl. by A.R.H.

N81-11914# Societe Nationale Industrielle Aerospatiale, Paris (France). Aircraft Div.
ORGANIZING A DESIGN-TO-COST PROGRAM
Robert Tassinari *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 14 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Total cost control at all development and production stages is a prerequisite to any significant design-to-cost (DTC) program. Design to life cycle cost (DTLCC) methods further require intimate knowledge of operational and maintenance costs. Specialists in this cost management method are aware of these two principles. Less obvious, perhaps are the great advantages to be derived through an organization specifically trained in the application of DTC and DTLC principles. A specialized organization and methods for integrating costs into all phases of new programs was created much in the way that weights were calculated into programs in the past. To keep pace with this reorganization in development, emphasis was placed on training personnel in value analysis and DTC methods. Results of these efforts first became apparent in 1977, during development of the A 200. Today, the same principles are being applied in development of the A 310. E.D.K.

N81-11915# American Airlines, Inc., Tulsa, Okla.
A NEW METHOD FOR ESTIMATING TRANSPORT AIRCRAFT DIRECT OPERATING COSTS
Keith Grayson *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 20 p refs (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

A means of estimating aircraft direct operating costs for comparative purposes was developed which was able to recognize and include the potential benefits to be gained from technology and design innovation when applied to commercial transport aircraft. The work performed on this subject is reviewed. The validity of the developed methods and how they can be used in the evaluation of aircraft for an airline's fleet is also demonstrated. E.D.K.

N81-11916# Societe Nationale Industrielle Aerospatiale, Marignane (France.)
DESIGN-TO-COST APPLIED TO THE AS350 HELICOPTER [LE DESIGN TO COST APPLIQUE A L'HELICOPTERE AS350]
Rene Mouille *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 18 p In FRENCH (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

In order to remain competitive on the international market, cost reduction studies were undertaken at Aerospatiale and were concretized in the design of the AS350 helicopter after two years' effort by a small experimental research group. The development of this helicopter, which is definitely more economical than the Alouette 2 or the Gazelle, has followed the same cost reduction spirit as was used in its design. The method is classic and is based on (1) analysis of the value of functions and of the parts assuring these functions; (2) criticism of the solution; (3) search for new solutions; and (4) choice of compromises. The experience of the participants permitted rapid elimination of the most expensive choice as well as those with least performance. The benefits to be obtained from proceeding correctly from the design stage can be very important with regards to both acquisition and utilization costs. This is of interest to both civil and military users. Transl. by A.R.H.

N81-11917# United Air Lines, Inc., San Francisco, Calif.
RELIABILITY-CENTERED MAINTENANCE
F. S. Nowlan *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 13 p refs (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The use of reliability centered maintenance principles are discussed with respect to aircraft component life cycle costs. The following inherent reliability characteristics are emphasized: failure consequences, judged by the effect of loss of function on safety, mission capability and operational readiness; failure modes which lead to an item's loss of function; exposure to secondary damage that results from certain failure modes; visibility of the failure process and a mechanic's ability to discover potential failures and thereby prevent functional failures; evidence by which the operating crew can realize that a functional failure has occurred; exposure to the consequences of multiple failures; and failure rates. R.C.T.

N81-11918# British Aerospace Aircraft Group, Preston (England).
SOME ENGINEERING ASPECTS OF LIFE CYCLE COSTING
G. W. Bleasdale *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 9 p refs (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The constituents that are common to most life cycle cost methods are identified. Ways in which some of the engineering costs can be minimized are discussed. It is shown that the extra cost of better engineering design may increase the acquisition cost but this will be more than offset by the large reduction in support costs complemented by the increase in reliability and aircraft availability. Examples are given showing typical contributions to high support costs of mechanical components. R.C.T.

N81-11919# Northrop Corp., Hawthorne, Calif. Aircraft Group.
BALANCED DESIGN: MINIMUM COST SOLUTION
E. Huie and H. F. Harris *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 8 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The application of life cycle cost analysis is discussed and the techniques used to assessed life cycle costs during the different phases of weapon system development are described. An illustrative case study showing the benefits of the application of life cycle costing on availability, sustained sorties, and requirements are presented. R.C.T.

N81-11920# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
DESIGN TO COST AND SYSTEMS, LCC
Klaus Wickel *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 9 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Different aspects of the design to costs approach are addressed with special attention given to their operational and maintenance cost and methodological implications. Three major subtasks of the design to cost task are examined: design to financial feasibility; design to personnel feasibility; and design to system's life cycle costs. It is shown that design to cost is indisputably an absolutely essential approach to tackling the cost problems as long as the objective does not degenerate to mere design to financial feasibility. R.C.T.

N81-11921# British Aerospace Aircraft Group, Preston (England).
IMPACT OF MAINTAINABILITY OF LIFE CYCLE COSTS
G. R. Thornber *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 11 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The interpretation of the definitions of the varied parameters used in assessing maintainability with respect to their significant effect on the quantification of the effect on life cycle cost. One possible interpretation is considered and the results obtained using this are indicated. Methods of assessing maintainability as applied to two international collaborative military aircraft are considered and some of the lessons and problems encountered are addressed. R.C.T.

N81-11922# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
ESTIMATION OF RELATIVE TOTAL COST FOR AIRCRAFT SYSTEMS
J. Bollmann and H. Lankenau *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 9 p refs (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

A suitable method for determining the relative total costs (fixed and operating costs) is described. It is shown that during the operating phase a clear statistical comparison must continuously be accomplished between the target and the actual values in order to ensure that any deviations and the causes of such deviations can be detected and eliminated. The need to have an agreed procedure between operator, aircraft manufacturer and equipment supplier is emphasized. R.C.T.

N81-11923# Messier-Hispano-Bugatti S.A., Montrouge (France).
USING COST REDUCTION CONCEPTS AT MESSIER-HISPANO-BUGATTI [MISE EN OEVRE DES CONCEPTS DE REDUCTION DES COUTS CHEZ MESSIER-HISPANO-BUGATTI]
M. Eslinger *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 11 p In FRENCH (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

Industrialization, value analysis, production cost objective, and life cycle cost objective are four concepts used at M-H-B to reduce the cost of products such as landing gear, hydraulic equipment, wheels, and brakes. Each of these concepts is examined, and the means necessary for their implementation are indicated. Results of using these techniques are described. Transl. by A.R.H.

N81-11924# Gabelman (Irving J.) Technical Associates, Rome, N.Y.
SUMMARY OF AGARD LECTURE SERIES 100: METHODOLOGY FOR CONTROL OF LIFE CYCLE COSTS FOR AVIONICS SYSTEMS
Irving J. Gabelman *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 8 p Lecture held in Bonn, 7-8 May 1979 and in Athens, 10-11 May 1979 (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The continually increasing cost of avionics and weapons systems between aquisition and their lifetime operation are discussed. Specific emphasis is given to the following: elements of life cycle costs; parametric cost analysis; and life cycle cost methodology. R.C.T.

N81-11925# Marconi Avionics Ltd., Rochester (England).
DESIGN TO COST VIEWED AGAINST THE ACHIEVEMENT OF OPTIMUM SYSTEM CAPABILITY
R. G. Rose *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 6 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The criteria for defining the cost of avionics systems are discussed. Two types of costs are specifically described: one time costs and recurring costs. One time costs include design and development, manufacture, training, documentation and facilities. Recurring costs include retraining where necessary, post design improvement studies, operating and maintenance costs and transportation and handling. These two groups are interactive in as much as poor design usually results in heavy maintenance costs and design for the reduction of operating and maintenance costs will usually result in higher design and development costs for the achievement of the results required. There is another point in product design that must be considered as part of assets management, and that is the required availability or state of readiness of the equipment to perform the tasks for which it was developed. R.C.T.

N81-11926# Ministry of Defence, London (England).
SUMMARY OF AGARD LECTURE SERIES 107: THE APPLICATION OF DESIGN TO COST AND LIFE CYCLE COST TO AIRCRAFT ENGINES
E. J. Jones *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 5 p Lecture held in Saint Louis, France 12-13 May 1980 and in London, 15-16 May 1980 (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The latest methodologies of cost/performance comparison and trade offs for aircraft engines are examined. Information includes data collection, analysis, modelling and estimating all development and operations costs. R.C.T.

N81-11927# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
THE ROLE OF ADVANCED TECHNOLOGY OF TURBINE ENGINE LIFE CYCLE COST
Robert F. Panella, Michael A. Barga, and Richard G. McNally *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 13 p refs (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The advanced technology of the turbine engine and its impact on life cycle costs (LCC) is addressed. To adequately assess this advanced technology, LCC techniques are to be developed which are sensitive to performance, structural design, manufacturing processes, reliability and maintainability. These techniques are then used to determine the performance/life/cost trade-offs of the advanced technology. An overview of current efforts in LCC techniques, and trade-offs is given. R.C.T.

N81-11928# Lucas Aerospace Ltd., Birmingham (England). Engine Management Div.
COST CONSIDERATIONS OF ENGINE FUEL CONTROL SYSTEMS
A. J. Eccleston *In* AGARD Design to Cost and Life Cycle Cost Jul. 1980 14 p (For primary document see N81-11902 02-81)
Avail: NTIS HC A15/MF A01

The manufacture of hydromechanical systems is discussed. It is shown that by applying well tried principles a value engineering team can identify considerable potential savings, particularly in the case of new designs. While lower life cycle costs are frequently only achieved at the expense of increased first cost this is not invariably so. R.C.T.

N81-11979*# Alabama Univ. in Huntsville.
MSFC PERSONNEL MANAGEMENT TASKS: RECRUITMENT AND ORIENTATION OF NEW EMPLOYEES
Thomas A. Brindley *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 20 p (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N81-11929# Institute for Defense Analyses, Arlington, Va. Technical Information Services Office.
HOW TO GET IT: A GUIDE TO DEFENSE-RELATED INFORMATION RESOURCES, REVISED Final Report
Oct. 1980 494 p refs
(Contract MDA903-79-C-0320)
(AD-A090000; IDA-P-1500; DTIC-TR-80/6; IDA/HO-80-22551) Avail: NTIS HC A21/MF A01 CSCL 05/2

This guide is intended for all who have to identify or acquire government published or sponsored documents, maps, patents, specifications or standards and other resources of interest to the defense community. The entries are arranged alphabetically, in a single list, by document type, source, acronym, series designation, or short title. Each entry consists of an identification of the item and detailed acquisition information such as source, order forms to use, cost, where indexed, and telephone numbers for additional information. A bibliography is included. GRA

N81-11930# Stanford Univ., Calif. Computer Science Dept.
EXPLORING THE USE OF DOMAIN KNOWLEDGE FOR QUERY PROCESSING EFFICIENCY
Jonathan J. King Dec. 1979 25 p refs
(Contract MDA903-77-C-0322)
(AD-A089911; SU-STAN-CS-79-781; HPP-79-30) Avail: NTIS HC A02/MF A01 CSCL 05/2

An approach to query optimization is described that draws on two sources of knowledge: real world constraints on the values for the application domain served by the database; and knowledge about the current structure of the database and the cost of available retrieval processes. Real world knowledge is embodied in rules that are much like semantic integrity rules. The approach, called 'query rephrasing', is to generate semantic equivalents of user queries that cost less to process than the original queries. The operation of a prototype system based on this approach is discussed in the context of simple queries which restrict a single file. The need for heuristics to limit the generation of equivalent queries is also discussed, and a method using 'constraint thresholds' derived from a model of the retrieval process is proposed. GRA

N81-11931# Stanford Univ., Calif. Dept. of Computer Science.
READ-ONLY TRANSACTIONS IN A DISTRIBUTED DATA BASE
Hector Garcia Molina (Princeton Univ., N.J.) and Gio Wiederhold Apr. 1980 27 p refs Sponsored in part by Defense Advanced Research Projects Agency, Arlington, Va.
(Grant N00039-80-G-0132)
(AD-A089913; SU-STAN-CS-80-797) Avail: NTIS HC A03/MF A01 CSCL 09/2

A read-only transaction or query is a transaction which does not modify any data. Read-only transactions could be processed with general transaction processing algorithms, but in many cases it is more efficient to process read-only transactions with special algorithms which take advantage of the knowledge that the transaction only reads. This paper defines the various consistency and currency requirements that read-only transactions may have. The processing of the different classes of read-only transactions in a distributed database is discussed. The concept of R insularity is introduced to characterize both the read-only and update algorithms. Several simple update and read-only transaction processing algorithms are presented to illustrate how the query requirements and the update algorithms affect the read-only transaction processing algorithms. GRA

N81-11932# *Naval Postgraduate School, Monterey, Calif.*
A DIMENSIONALITY REDUCTION TECHNIQUE FOR ENHANCING INFORMATION CONTEXT M.S. Thesis

Michael Lee Maurer Jun. 1980 185 p refs
(AD-A090158) Avail: NTIS HC A09/MF A01 CSCL 09/2

A computer processing technique is advanced which seeks to retain or improve data information context while reducing the dimensionality of data representation. Defining information context as the relative proximity of data points, a nonlinear transformation is analytically derived which utilizes Euclidean distance to one or more reference points to provide a measure similarity between data points. The nonarbitrary reference points are selectively manipulated to provide, given certain constraints, a unique mapping from high dimensional space to one or more dimensions for each point in space. The transformation process enhances class clustering and interclass separation in the lower dimensional representation. Computer processed experimental results are presented of reduction from 32, 10, 3 space into 2 space for both synthetic and real world data. Utilizing a ratio of intraclass variance to interclass variance as a figure of merit and as one possible optimization criterion, this technique yielded a significant ratio improvement in mapping from higher dimensional space into 2 dimensional space for all cases examined. GRA

N81-11933# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.

MANAGEMENT OF OBJECT HISTORIES IN THE SWALLOW REPOSITORY

Liba Svobodova Jul. 1980 87 p refs
(Contract N00014-75-C-0661)
(AD-A089836; MIT/LCS/TR-243) Avail: NTIS HC A05/MF A01 CSCL 09/2

SWALLOW is an experimental distributed data storage system that provides personal computers with a uniform interface to their local data and the data stored in shared remote servers called repositories. The SWALLOW repositories provide reliable, secure, and efficient long-term storage for both very small and very large objects and support updating of a group of objects at one or several repositories in a single atomic action. The repositories support, with some minor modifications, the object model developed by Reed (REED 78). The core of the repository is stable append-only storage called the Version Storage (VS). VS is the only stable storage in the repository. It contains the histories of all objects in the repository and all the information needed for crash recovery. It is assumed that VS will be implemented with write-once storage devices such as optical disks. The upper 2(n) words of VS are kept in the Online Version Storage (OVS). Techniques similar to real-time garbage collection are used to keep the current versions of frequently used objects in OVS. Two different policies for retaining current versions of objects in OVS are investigated; the actual implementation further depends on the type of storage devices used for OVS. A critical concern addressed throughout the design of the repository is recovery from system crashes and storage device failures. The crash recovery of the repositories is based entirely on the information contained in VS; VS is scanned sequentially, starting from its current end, until all objects histories have been reconstructed. GRA

N81-11934# Department of Energy, Oak Ridge, Tenn. Technical Information Center.

ENERGY INFORMATION DATA BASE: CORPORATE AUTHOR ENTRIES

Mar. 1980 92 p
(DOE/TIC-4585/R1-Suppl-5) Avail: NTIS HC A05/MF A01

A means for the consistent citing of the names of organizations in bibliographic records is presented. In general, an entry in Corporate Author Entries consists of the seven digit code number assigned to the particular corporate entity, the two letter country code, the largest number of the corporate name, the location of the corporate entity, and the smallest element of the corporate name. This supplement contains additions to the base document *and is intended to be used with that publication.* DOE

N81-11935# California Univ., Livermore. Lawrence Livermore Lab.

ASCOT DATA BASE MANAGEMENT SYSTEM

J. Barbieri, R. Nyholm, C. Castro, and K. Hill Jul. 1980 22 p refs
(Contract W-7405-eng-48)
(UCID-18752) Avail: NTIS HC A02/MF A01

A data base management system is designed to handle the data produced by both the experimental and theoretical efforts of the Atmospheric Studies in Complex Terrain project. The data base envisioned is hierarchically structured, sparse, and compact. Information concerning any given data file is stored in a directory file. The data base management system uses a relational data management approach. Three management schema are developed for use with the data base. DOE

N81-11936# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.

APPLICATION OF WORD PROCESSING TO ENGINEERING DOCUMENTATION

C. J. McGirr 25 Aug. 1980 13 p refs
(Contract DE-AC04-76DP-00656)
(GEPP-TIS-519) Avail: NTIS HC A02/MF A01

Word processing increased the production rate of engineering documents at the General Electric Neutron Devices Department. Time reductions were 10 percent for original typing, 35 percent for document revisions, and 90 percent for repetitive typing. Total man hours saved annually were 1155. The system consists of two work stations, a master central processing unit, and a daisy printer. These are ties into a large scale computer. DOE

N81-11937# Los Alamos Scientific Lab., N. Mex.

GENERALIZED ULTRASONIC SYSTEM FOR MICROCOMPUTER CONTROLLED DATA COLLECTION

Ronald D. Strong 1980 7 p Presented at DARPA/AFML Review of Progress in Quantitative NDE Conf., La Jolla, Calif., 14-17 Jul. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2040; CONF-800767-1) Avail: NTIS HC A02/MF A01

A system developed for the automated scanning of objects with an axis of rotation is described. This system is being expanded to allow greater versatility in the motions. Data which was collected using the system and some typical test objects are also presented and discussed. DOE

N81-11938# Oak Ridge National Lab., Tenn. Energy Div.

INTEGRATED APPROACH TO DATA EDITING

Gunar E. Liepins and David J. Pack 11 Aug. 1980 32 p refs Presented at the Am. Statist. Soc. Meeting, Houston, Tex., 11 Aug. 1980
(Contract W-7405-eng-26)
(CONF-800820-5) Avail: NTIS HC A03/MF A01

Localization of error in particular fields of categorical records from large data sets that fail to fall in a deterministically known constrained space is addressed. A simulation study of a compromise in which the weights are related to the number of active failed edits and/or the number of active passed edits for a field is described. Formulation problems must be dealt with to produce a fully integrated approach to data editing. DOE

N81-11939# California Univ., Berkeley. Lawrence Berkeley Lab. Employee and Information Services Div.

COMPUTER-AIDED VISUALIZATION OF DATABASE STRUCTURAL RELATIONSHIPS

David F. Cahn Apr. 1980 10 p refs Presented at the 43d Ann. Meeting of the Am. Soc. for Inform. Sci., Anaheim, Calif., 5-10 Oct. 1980
(Contract W-7405-eng-48)
(LBL-10437; CONF-801008-1) Avail: NTIS HC A02/MF A01

*Interactive computer graphics displays are useful in augment*ing understandability of data structures. In complexly interrelated domains such as bibliographic thesauri and energy information systems, node and link displays represent one such tool. Examples of data structure representations found useful in these domains *are presented.* DOE

N81-11940# Sandia Labs., Albuquerque, N. Mex.

***IMPLEMENTATION OF LOGICAL NETWORKS IN SYSTEM* 2000 DATA BASES**

Ronald C. Hall May 1980 27 p *refs* Presented at the 1980 Fall Conf. of the Assoc. of System 2000 Users for Tech. Exchange (ASTUTE), San Francisco, 6 Oct. 1980

(Contract DE-AC04-76DP-00789)
(SAND-80-1252C; CONF-801007-1) Avail: NTIS HC A03/MF A01

The need for a means to express general relationships (networks) among entity occurrences (data sets) in System 2000 data bases is established. Integer expression of general path segments is described as a means to meet this need. Operations on the expressions are also described. Two possible implementations are discussed. They are compatible with the System 2000 hierarchical data model. DOE

N81-11941# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
PATENTS: AN INFORMATION RESOURCE
Sep. 1980 144 p refs Lecture held at Munich, 13-14 Oct. 1980 and at Delft, Netherlands, 16-17 Oct. 1980
(AGARD-LS-112) Avail: NTIS HC A07/MF A01

Patents, an important part of the total spectrum of scientific and technical information, are often overlooked by the information community and the scientific and technical community. These communities must be more aware of the importance of patents to the research, development, and engineering efforts in each country. The wide range of applications for information from patents and the methods that can be used for acquiring that information are emphasized. Methods used for indexing and classifying are discussed, the various available abstracting services are compared, and techniques for searching including automated systems are described. For individual titles, see N81-11942 through N81-11951.

N81-11942# British Library, London (England).
THE PLACE OF PATENTS IN THE FIELD OF SCIENTIFIC AND TECHNICAL INFORMATION
Michael W. Hill *In* AGARD Patents: An Inform. Resource Sep. 1980 6 p refs (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

The history of patents for inventions and printed patent specifications is briefly sketched. The usefulness of patent information to research and development, industry, and commerce is indicated. The ways and means of storing and retrieving such information is also discussed. E.D.K.

N81-11943# Commissariat a l'Energie Atomique, Gif-sur-Yvette (France).
THE CASE FOR USING PATENT DOCUMENTATION (ITS UNIQUE CONTENT, ILLUSTRATIONS OF ITS APPLICATION)
Maurice G. Lenoir *In* AGARD Patents: An Inform. Resource Sep. 1980 22 p refs In ENGLISH and FRENCH (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

The information contained in patents is largely exclusive and yet, also offers qualities and characteristics enabling one to reach conclusions and make decisions which the usual technical documentation material does not always permit. The advantages users are likely to derive from this type of information is outlined. E.D.K.

N81-11944# General Electric Co., Philadelphia, Pa.
CORPORATE MANAGEMENT OF PATENTS: ROLE OF THE INDUSTRIAL LIBRARIAN
Larry Chasen *In* AGARD Patents: An Inform. Resource Sep. 1980 21 p refs (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

The librarian, who is seldom the direct user of patents, should become knowledgeable in the rich resources of patent data. Technology transfer can be accomplished by the engineer and scientist having the complete picture which the librarian offers in response to a search request. Major library schools were questioned on whether courses in patent information are part of the curriculum requirements of a special librarian. The other survey is directed to several dozen major industrial libraries in the United States on patent handling and management. The results of these surveys are given. Although there are over 30 patent depositories in the United States, the average research librarian does not make complete use of these depositories. In some cases, the survey indicated they were unaware of these data sources. Several key patents supported by library research are described. On line retrieval systems where patent license data is offered by NASA and DTIC are an example of sources available to the aerospace librarian. A forecast of how libraries and special libraries will retrieve patents and patent applications before the next century commences is presented. E.D.K.

N81-11945# Patent and Trademark Office, Washington, D. C.
TECHNOLOGY ASSESSMENT: A TOOL FOR EXPLOITING PATENTS
Alfred C. Marmor *In* AGARD Patents: An Inform. Resource Sep. 1980 25 p ref (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

Patent document collections, chronologically arranged and technically categorized, represent unique records of technological change. Continuously generated and catalogued, patent literature can be drawn upon as valuable input to technology assessment processes, both from a current and a historical perspective. Comprehensive patent information packages can be developed and tailored to benefit corporate strategists, policy analysts, educators, entrepreneurs, future innovators and the like. The recently established Technology Assessment and Forecast Program has helped, through computerized manipulation of patent bibliographic and classification data, to expand and facilitate the use of patent information in this way. They can profile the patent-active corporations and government organizations in the field, and identify national origin of the technology. Patenting by selected corporations may be reviewed to explore the depth and range of their technological activity. E.D.K.

N81-11946# Naval Material Command, Washington, D. C.
TECHNOLOGY TRANSFER: LICENSING GOVERNMENT INVENTIONS TO INDUSTRY
Sherman Gee *In* AGARD Patents: An Inform. Resource Sep. 1980 14 p refs (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

Invention technology constitutes a sizeable portion of the science and technology base in the United States, but in the public domain it is underutilized. Only a small fraction of government inventions are licensed by industry. In order to stimulate greater utilization and licensing of government inventions, government agencies are becoming more disposed towards granting exclusive licenses under certain conditions. In order to develop better insight into government efforts to promote private sector licensing of government inventions, the licensing activities of the Department of the Navy and the National Technical Information Service are highlighted. More licensing of government inventions by industry expedites the flow of technology from the public to private sector. Close cooperation between the licensing and technology transfer communities is desired to help accelerate the rate of government inventions licensing and to improve the chances for technology transfer success. E.D.K.

N81-11947# British Library, London (England).
LIBRARY NETWORKS IN WESTERN EUROPE AND NORTH AMERICA
Michael W. Hill *In* AGARD Patents: An Inform. Resource Sep. 1980 6 p refs (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

In most, if not all, the member countries of NATO, the National Patent Office is the most obvious place to go to when wishing to use patent documents for information purposes. In the Search Room, or the Library, or in a combination of the two - arrangements vary from one country to another - facilities are provided for members of the public (meaning anyone other than a Patent Office Official) to conduct searches for themselves. In several countries, however, there are also in some major towns and cities libraries which hold collections of patent literature and which also are open to anyone who cares to use them. A summary of the available library resources in Denmark, France, Germany, the United Kingdon, and the United States of America is included. E.D.K.

N81-11948# Deutsches Patentamt, Munich (West Germany).
DISSEMINATION OF PATENT INFORMATION THROUGH OFFICIAL SERVICES AND CORRESPONDING RESOURCES

IN EUROPE (SEEN THROUGH THE EYES OF A PATENT OFFICE OFFICIAL)
Rudolf Schiffels *In* AGARD Patents: An Inform. Resource Sep. 1980 8 p (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

Reasons for dissemination needs of patent information are discussed. The different means of disseminating patent information are by making patent documentations available, through additional consulting services for researchers, and by additional search aids. The different kinds of users of such information are analyzed, including existing and potential users. The role of official services in patent information dissemination is described. E.D.K.

N81-11949# Centre for Scientific and Technical Information and Documentation TNO, Delft (Netherlands).
THE ROLE AND POSSIBLE ROLE OF OFFICIAL SERVICES IN THE DISSEMINATION OF PATENT INFORMATION
J. W. Plevier *In* AGARD Patents: An Inform. Resource Sep. 1980 6 p refs (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

Patent offices are considered as organizations which have available a source of well organized information and a large staff of highly specialized technical people with a high level of experience in dealing with information and information retrieval systems. These human and material resources are taken as a starting point for a discussion of a number of activities which might meet some of the information needs of society at large and industry in particular. Some of the items discussed are: study of the performance of retrieval systems; patent statistics and trend analysis; scouting activities; and making available patent information in a comprehensible form for nonpatent specialists. E.D.K.

N81-11950# British Library, London (England).
COMMERCIAL ABSTRACTING AND INDEXING SERVICES, PRINTED AND ON-LINE
D. Greenwood and Michael W. Hill *In* AGARD Patents: An Inform. Resource Sep. 1980 11 p (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

On-line computer systems provide a simple and versatile method for fulfilling the needs of people working in the patent information field. Access to commercial files held in various computers in the US and Europe can now be obtained relatively easily through international communications networks, and there is no doubt that the number of available files will increase. Information workers are nowadays quite used to this technology: it has become a common-place and those who wish to search for patents information can find a number of data bases designed to meet their needs. E.D.K.

N81-11951# British Library, London (England).
PATENT INFORMATION: LOOKING AHEAD
Michael W. Hill *In* AGARD Patents: An Inform. Resource Sep. 1980 4 p refs (For primary document see N81-11941 02-82)
Avail: NTIS HC A07/MF A01

A great deal of progress was made due to the work of ICIREPAT and WIPO. Commercial operations provide a wealth of detailed abstracting services covering most of the important subject areas. Methods of dealing with patent information were strengthened, and a number of other on-line and printed services are now available. E.D.K.

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N81-11952*# Mechanical Technology, Inc., Latham, N. Y. Stirling Engine Systems Div.
AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM Quarterly Technical Progress Report, 30 Mar. - 28 Jun. 1980
Merton Allen, ed. Aug. 1980 96 p refs
(Contract DEN3-32; EC-77-A-31-1040)
(NASA-CR-165134; DOE/NASA/0032-80/8; MTI-80ASE144QT9) Avail: NTIS HC A05/MF A01 CSCL 13F

Progress is reported in the following: the Stirling reference engine system design; components and subsystems; F-40 baseline Stirling engine installation and test; the first automotive engine to be built on the program; computer development activities; and technical assistance to the Government. The overall program philosophy is outlined, and data and results are given. A.R.H.

N81-11953*# AiResearch Mfg. Co., Phoenix, Ariz.
COST/BENEFIT ANALYSIS OF ADVANCED MATERIALS TECHNOLOGY CANDIDATES FOR THE 1980'S, PART 2 Final Report
R. E. Dennis and H. F. Maertins Aug. 1980 106 p refs
(Contract NAS3-20073)
(NASA-CR-165176; AIRESEARCH-21-3663-PT-2) Avail: NTIS HC A06/MF A01 CSCL 05A

Cost/benefit analyses to evaluate advanced material technologies projects considered for general aviation and turboprop commuter aircraft through estimated life-cycle costs, direct operating costs, and development costs are discussed. Specifically addressed is the selection of technologies to be evaluated; development of property goals; assessment of candidate technologies on typical engines and aircraft; sensitivity analysis of the changes in property goals on performance and economics, cost, and risk analysis for each technology; and ranking of each technology by relative value. The cost/benefit analysis was applied to a domestic, nonrevenue producing, business-type jet aircraft configured with two TFE731-3 turbofan engines, and to a domestic, nonrevenue producing, business type turboprop aircraft configured with two TPE331-10 turboprop engines. In addition, a cost/benefit analysis was applied to a commercial turboprop aircraft configured with a growth version of the TPE331-10. M.G.

N81-11954# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. Electrochemistry Div.
BASELINE TESTS OF THE ELECTRA VAN MODEL 1000 ELECTRIC VEHICLE Test Report, 20 Sep. - 28 Nov. 1978
Edward J. Dowgiallo, Jr., Ivan R. ONellings, William H. Blake, and Kevin F. Krause Jul. 1980 70 p
(Contract EC-77-A-31-1042)
(AD-A090113; MERADCOM-2305) Avail: NTIS HC A04/MF A01 CSCL 21/3

The Electra Van model 1000, an electric half-ton multipurpose van, was tested at MERADCOM as part of a Department of Energy project to characterize the state-of-the-art of electric vehicles. The Electra Van is manufactured in Austin, Texas by

Jet Industries, Inc. It is powered by 24, 6 volt batteries that are connected to the motor through an SCR controller actuated by a foot pedal to control motor speed. The 28 horsepower motor drives the rear wheels through a three speed manual transmission. No regenerative braking is provided. GRA

N81-11955# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY STORAGE SYSTEMS FOR AUTOMOBILE PROPULSION: 1979 STUDY. VOLUME 1: OVERVIEW AND FINDINGS
H. C. Forsberg, C. J. Anderson, E. Behrin, W. Cliff (Battelle Pacific Northwest Labs., Richland, Wash.), R. Crisp (Arkansas Univ., Fayetteville), C. L. Hudson (Interplan Corp., Santa Barbara, Calif.), L. G. OConnell, J. S. Payne, R. Renner, and M. D. Schrot 15 Dec. 1979 93 p
(Contract W-7405-eng-48)
(UCRL-52841-Vol-1) Avail: NTIS HC A05/MF A01

Technical and cost analyses of energy storage devices and propulsion systems for automobiles were conducted. Study panels examined electrochemical, mechanical, and chemical/thermal storage devices, selected the most promising ones, and projected their characteristics into three time frames through 2000. The Automotive End Use Panel modeled these devices and propulsion systems as vehicles of several sizes and performance levels and prepared comparative evaluations between systems and with projected baseline internal combustion engine vehicles. DOE

N81-11956# Department of Energy, Washington, D. C.
ELECTRIC AND HYBRID VEHICLE SELF-CERTIFICATION AND VERIFICATION PROCEDURES: MARKET DEMONSTRATION PROGRAM
Mar. 1980 17 p Revised
(DOE/CS-0178-Rev-1) Avail: NTIS HC A02/MF A01

The process by which a manufacturer of an electric or hybrid vehicle certifies that his vehicle meets the DOE Performance Standards for Demonstration is described. Such certification is required for any vehicles to be purchased under the Market Demonstration Program. The verification testing process followed by DOE for testing to verify compliance is described. Manufacturer responsibilities are outlined and procedures for recertification of vehicles that have failed verification testing are presented. DOE

N81-11957# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
MODELING APPROACHES TO LONG-RUN INTEGRATED TECHNOLOGICAL IMPACT ANALYSIS
Paul J. Croncki Dec. 1979 24 p refs
(Contract DE-AC02-76CH-00016)
(BNL-51126) Avail: NTIS HC A02/MF A01

Analysis of the energy economic environmental impacts of energy policies, such as a major synthetic fuels program, requires methodologies that reflect the potential benefits and costs of proposed policy alternative. Energy policies typically have secondary economic and environmental effects as well as direct effects on energy itself, and these must collectively be assessed to provide a complete basis for policy selection. The focus of this report is on approaches to the analysis of long term impacts that may result from current decisions regarding energy policy. The interrelationships among the energy, economic, and environmental systems and alternative ways of analyzing long term impacts within an integrated framework are discussed. An application of such a framework to the assessment of a major synthetic fuels program is presented as an example. The use of idealized problem formulations is a necessary part of technology assessment, particularly in considering highly integrated policy issues, such as a synfuels policy. DOE

N81-11958# Department of Energy, Washington, D. C.
ASYNCHRONOUS DRIVE FOR AN ELECTRIC AUTOMOBILE UNDER SLIP CONDITIONS
D. B. Izosimov 1979 7 p Transl. into ENGLISH from 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 7 p Conf. held at Erevan, USSR, 1979
(DOE-Tr-230) Avail: NTIS HC A02/MF A01

The good power and performance specifications of an asynchronous motor are due to the simplicity of its design and the absence of sliding contacts, which provide high reliability, safety and the possibility for designing an individual drive for the motor-wheel from an onboard power source (inverter). The structure of the control system of such a drive is discussed. DOE

N81-11959# Department of Energy, Washington, D. C.
DC THYRISTOR-CAPACITOR CONVERTER FOR AN ELECTRIC AUTOMOBILE
O. G. Bulatov and A. I. Tsarenko 1979 7 p Transl. into ENGLISH from 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 7 p Conf. held at Erevan, USSR, 1979
(DOE-Tr-232) Avail: NTIS HC A02/MF A01

The use of a high-frequency converter with series capacitor switching for regulation of a dc motor is proposed. Also the results of a comparison of the proposed converter with series capacitor switching and a converter with LC-circuit switching are presented. Basic diagrams of the power side of the compared converters with respect to the use of them in an electric automobile are provided. DOE

N81-11960# Department of Energy, Washington, D. C.
METHODS FOR PERFECTING NICKEL-ZINC STORAGE BATTERIES FOR THE POWER PLANTS OF ELECTRIC AUTOMOBILES
N. S. Lidorenko, V. I. Baulov, and V. Ye. Dmitrenko 1979 6 p Transl. into ENGLISH from 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 6 p Conf. held at Erevan, USSR, 1979
(DOE-Tr-231) Avail: NTIS HC A02/MF A01

Analysis of the results of bench tests of test models of storage batteries and tests of three sets of batteries in an electric automobile made it possible to determine methods for further perfecting nickel-zinc storage batteries for the power plants of electric automobiles. These methods are discussed. DOE

N81-11961# Department of Energy, Washington, D. C.
SELECTION OF POWER RATIOS IN THE ELECTRICAL EQUIPMENT OF AN ELECTRIC AUTOMOBILE WITH COMBINATION-TYPE POWER PLANT
A. A. Momdzhyan 1979 6 p Transl. into ENGLISH from the 2nd Sov.-Am. Symp. on Elect. Automobiles (USSR), 1979 6 p Conf. held at Erevan, USSR, 1979
(DOE-Tr-236) Avail: NTIS HC A02/MF A01

Due to the absence of a generally accepted method for selecting the basic parameters of power sources in electric automobiles with combination-type power plants, an algorithm was developed for solving the problem on a computer. Existing analytical dependences for power design for vehicles, equations for electric traction motors and SP equations obtained on the basis of the results of experimental research, as well as internal combustion engine equations, also obtained on the basis of results of experimental research, were used in the solution. DOE

N81-11962# Department of Energy, Washington, D. C.
RESEARCH AND OPTIMIZATION OF STATIC OPERATING CONDITIONS FOR BATTERY-POWERED ELECTRIC AUTOMOBILES
V. S. Varpetyan and A. P. Tarasyan 1979 8 p Transl. into ENGLISH from Russian Meeting Presented at 2nd Sov.-Am. Symp. on Elect. Automobiles, Erevan, USSR, 1979 7 p
(DOE-Tr-235) Avail: NTIS HC A02/MF A01

The majority of modern electric automobiles is produced with series wound dc motors powered by lead-acid storage batteries through thyristor pulse width converters. In addition to the known power advantages of a drive with an SWM, the use of it in an electric automobile involves certain circuit complications in the power circuits for pulse-regenerative braking and in the traction modes with reduction of the SWM magnetic flux. Despite the traditional use of SWMs as traction engines for electric automobiles, it is possible to achieve optimum control of the operational modes of the self-contained system. Features of battery-powered electric automobiles are the presence of a significant mutual influence between the characteristics and indicators of the SB, PWC, drive motor and mechanical reducing gear and a change in the output figures for the system depending on the level of charge. DOE

N81-11963# Calspan Corp., Buffalo, N. Y.
CALSPAN/CHRYSLER RESEARCH SAFETY VEHICLE. PHASE 3, VOLUME 1: EXECUTIVE SUMMARY Final Technical Report
G. J. Fabian, ed. Apr. 1980 62 p refs
(Contract DOT-HS-7-01551)
(PB80-188428; DOT-HS805-322; CALSPAN-ZN-6069-V-32-1) Avail: NTIS HC A04/MF A01 CSCL 13F

A five passenger family car was designed to be fabricated by mass production techniques from materials chosen to minimize energy content, rare mineral requirements, and facilitate recycling for recovery and reuse. Using a combination of mathematical modeling on the computer with static and dynamic testing, design issues that remained at the completion of phase 2 were resolved; validation tests were conducted to demonstrate performance resulting from these design improvements; and the results were incorporated in the final design. Additional investigations defined emissions and fuel economy, documented the degree of RSV compliance with current Federal Motor Vehicle Standards, and studied the effect of the RSV design on collision repair, producibility, and cost of program goals. GRA

N81-11964# Falcon Research and Development Co., Buffalo, N. Y.
STUDY OF AUTOMOTIVE EMISSION CONTROL TECHNOLOGY: FUEL SWITCHING ANALYSIS Final Report
30 Jun. 1980 236 p refs Prepared in cooperation with Energy and Environmental Analysis, Inc., Arlington, Va. Sponsored in part by the National Commission on Air Quality
(PB80-207947; AQ-7243-2E; IR-5) Avail: NTIS HC A11/MF A01 CSCL 13F

The switching of fuel in operating vehicles designed to use unleaded gasoline or leaded gasoline is one of the major factors responsible for the failure of in-use vehicles to meet emission standards. The number of vehicles subject to fuel switching, the frequency at which it occurs and the impact on individual vehicle emissions were analyzed. A methodology is developed for predicting the total vehicle emissions impact of fuel switching, and projections are made of the increase in vehicle emissions from 1975 through 1990. GRA

N81-11965# Dynamic Science, Phoenix, Ariz.
FMVSS 212/219/301 TESTING OF ELECTRIC VEHICLES SOUTH COAST TECHNOLOGY-ELECTRIC VW (VOLKSWAGEN) RABBIT; BATTRONICS VAN Final Report
Mark Pozzi Nov. 1979 156 p
(Contract DOT-HS-5-01104)
(PB80-207954; DOT-HS-805402; Rept-3042-79-186/1540) Avail: NTIS HC A08/MF A01 CSCL 13F

Two electric vehicle-to-barrier head-on crash tests were conducted to determine if the vehicles would comply with the fuel spillage requirements of Federal Motor Vehicle Safety Standard (FMVSS) 301, Fuel System Integrity, the windshield retention requirements of FMVSS 212, and the windshield zone intrusion requirements of FMVSS 219. The standard fixed barrier was replaced by the NHTSA Fixed Test Device with 40 load cells for the SCT Rabbit crash test. GRA

88 SPACE SCIENCES (GENERAL)

N81-11966*# National Aeronautics and Space Administration, Washington, D. C.
VIKING ORBITER VIEWS OF MARS
M. H. Carr, W. A. Baum, K. R. Blasius, G. A. Briggs, J. A. Cutts, T. C. Duxbury, R. Greeley, J. Guest, H. Masursky, B. A. Smith et al 1980 189 p refs Original contains color illustrations
(NASA-SP-441) Avail: NTIS MF A01; SOD HC $9.50 CSCL 03B

Images acquired by the Viking orbiters, beginning in 1976 are presented. The pictures represent only a small fraction of the many thousands taken, and were chosen to illustrate the diverse geology of Mars and its atmospheric phenomena. Specific topics discussed include the Viking mission and its objectives, a brief comparison of Earth and Mars, and surface features of Mars including the great equatorial canyons, channels, volcanic and deformational features, and craters. Martian moons, surface processes, polar regions, and the Martian atmosphere are also covered. J.M.S.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N81-11967*# Mississippi State Univ., Mississippi State. Dept. of Electrical Engineering.
ANALYSIS OF SPACE TELESCOPE DATA COLLECTION SYSTEM Interim Final Report, 1 Jul. 1979 - 31 Oct. 1980
Frank Ingles and W. O. Schoggen Oct. 1980 117 p refs
(Contract NAS8-33570)
(NASA-CR-161596; MSSU-EIRS-80-3) Avail: NTIS HC A06/MF A01 CSCL 03A

The effects of frame synchronization loss were analyzed. A frame sync loss will create loss of data for the frame in which it occurs (since one would not know whether the preceding data was properly in sync or not) and during search from frame sync the system would be losing data. The search mode for reacquisition utilizes multiple search procedures. S.F.

N81-11968*# National Aeronautics and Space Administration, Washington, D. C.
HIGH ENERGY ASTRONOMY OBSERVATORY
[1980] 37 p refs Original contains color illustrations
(NASA-EP-167) Avail: NTIS HC A03/MF A01 CSCL 03A

An overview of the High Energy Astronomy Observatory 2 contributions to X-ray astronomy is presented along with a brief description of the satellite and onboard telescope. Observations relating to galaxies and galactic clusters, black holes, supernova remnants, quasars, and cosmology are discussed. M.G.

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N81-11969*# Colorado Univ., Boulder. Joint Inst. for Lab. Astrophysics.
STELLAR CHROMOSPHERES
Jeffrey L. Linsky 1980 15 p refs
(Contract NAS5-23274; Grant NGL-06-003-057)
(NASA-CR-163715) Avail: NTIS HC A02/MF A01 CSCL 03B

Developments in the understanding and use of chromospheric diagnostics are discussed with emphasis on the following aspects: (1) trends emerging from semiempirical models of single stars; (2) the validity of claims that theoretical models of chromospheres are becoming realistic; (3) the correlation between the widths of Ca 2 H and K line emission cores and stellar absolute luminosity extending over 15 magnitudes (Wilson-Bappu relation); and (4) the existence of systematic flow patterns in stellar chromospheres. A.R.H.

N81-11970*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MOTION ABOUT THE STABLE LIBRATION POINTS IN THE LINEARIZED, RESTRICTED THREE-BODY PROBLEM
Don Mittleman (Oberlin Coll., Ohio) Sep. 1980 159 p refs
(NASA-RP-1065; S-500) Avail: NTIS HC A08/MF A01 CSCL 03B

The motion of a point particle in the neighborhood of a triangular libration point (L sub 4 or L sub 5) in the linearized, restricted problem of three bodies in the plane is described. The derivation of the equations of motion is standard. From these equations, three invariants of the motion are obtained; the Jacobi integral is expressed linearly in terms of two of these. The trajectories for varied initial conditions are drawn, and a complete

geometric description of the particle motion is given in elementary terms. Each trajectory has an exterior boundary curve; its equation is found. An approximation to this boundary curve was known; the two curves are compared graphically. For certain initial conditions, there is an interior region from which the trajectory is excluded; the equation of the boundary of this region is given. M.G.

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N81-11971*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DYNAMICAL AND PHOTOMETRIC INVESTIGATION OF COMETS Final Report
Zdenek Sekanina 1980 26 p refs
(Grant NGR-09-015-159)
(NASA-CR-163699) Avail: NTIS HC A03/MF A01 CSCL 03B

The findings of dynamic and photometric investigations of comets are summarized, and include discussions of the comets Bennett 1970 II, Kohoutek 1973f, West 1976 VI, and periodic comets d'Arrest, Encke, and Swift Tuttle. The phenomena examined include striated and anomalous tails, tail composition and the dynamics of vaporizing dust particles, the evolution of dust jets, and split and dissipating comets. M.G.

N81-11972*# RAND Corp., Santa Monica, Calif.
COORDINATES OF FEATURES ON THE GALILEAN SATELLITES
E. Davies Merton and Frank Y. Katayama Nov. 1980 54 p refs Submitted for publication
(Contract NASw-3321)
(NASA-CR-163724; RAND/N-1617-JPL/NASA) Avail: NTIS HC A04/MF A01 CSCL 03B

Control nets of the four Galilean satellites, established photogrammetrically from pictures taken by the two Voyager spacecraft during their flybys of Jupiter in 1979, are discussed. Coordinates of 504 points on Io, 112 points on Europa, 1547 points on Ganymede, and 439 points on Callisto are listed. Selected points are indentified on maps of the satellites. Measurements of these points were made on 234 pictures of Io, 115 pictures of Europa, 282 pictures of Ganymede, and 200 pictures of Callisto. The systems of longitude were defined by craters on Europa, Ganymede, and Callisto. Preliminary solutions are found for the directions of the axes of rotation of the Galilean satellites. Mean radii are determined as 1815 + or - 5 km for Io, 1569 + or - 10 km for Europa, 2631 + or - km for Ganymede, and 2400 + or - 10 km for Callisto. M.G.

N81-11973*# McDonald Observatory, Austin, Tex.
PHOTOMETRY, SPECTROPHOTOMETRY AND POLARIMETRY OF COMET P/ENCKE DURING FALL OF 1979
Edwin S. Barker, Harlan J. Smith, and Anita L. Cochran 1 Oct. 1980 32 p
(Contract JPL-BP-708823)
(NASA-CR-163717; Rept-1) Avail: NTIS HC A03/MF A01 CSCL 03B

Broadband S-20, B and V magnitudes of P/Encke were obtained with the digital area photometer, using an Image Dissector Scanner (IDS) detector on the 2.7 m telescope at McDonald Observatory during August 1979. The notation V(S-20) is used for S-20 magnitudes transformed to V magnitudes. The variation in the V(S20) magnitudes (26, 5 minute integrations) on the best photometric night (21 August) was small and random indicating either a lack of rotational albedo variations or, more likely, a masking of the nucleus by the outburst activity. A spectrum covering the region from 3630 to 4900 A at a resolution of 5 A was obtained on 27 August with the IDS spectrograph. The spectrum was featureless, showing no emission at the CN or CO+ wavelengths. T.M.

N81-11974*# Lunar and Planetary Inst., Houston, Tex.
IMPLICATIONS FOR THE STRUCTURAL INTEGRITY OF THE VENUSIAN CRUST Final Report
John V. S. Harvey 1980 29 p refs Sponsored in part by NASA
(NASA-CR-163729) Avail: NTIS HC A03/MF A01 CSCL 03B

Comparisons of the fracture and yield stresses for the lithospheres of the Earth and Venus are derived from known empirical fracture and flow laws. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N81-11975# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 428. PART 1: PROMPT REPORTS, DATA FOR APRIL 1980, MARCH 1980
Helen E. Coffey, ed. May 1980 164 p refs
(PB80-212699; SGD-429-Pt-1; NOAA-80062401-Pt-1) Avail: NTIS HC A09/MF A01 CSCL 03B

In addition to an index for 1979-1980, data for April 1980 on: alert periods, daily solar indices, solar flares, solar radio emission, spacecraft observations, mean solar magnetic field, coronal holes, and Boulder Geomagnetic Substorm Log are presented. Data for March 1980 on: daily solar activity centers, sudden ionospheric disturbances, spacecraft observations, solar radio emission, cosmic rays, geomagnetic indices and radio propagation indices are presented. Late data included solar radio emission March 1980, cosmic rays February 1980, geomagnetic indices February 1980 and daily solar activity centers January 1980. GRA

N81-11976# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 429. PART 2: COMPREHENSIVE REPORTS, DATA FOR NOVEMBER 1979 AND MISCELLANEA
May 1980 44 p refs
(PB80-212707; SGD-429-Pt-2; NOAA-80062402-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 03B

In addition to an index for 1972-1980, data for November 1979 on: solar radio emission, energetic solar particles and plasma, and solar X-ray radiation are presented. Miscellaneous data consists of energetic solar particles October 1979, active regions August 13 - September 9, 1979, and synoptic solar maps August 13 - September 9, 1979. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N81-11991*# Berry Coll., Mount Berry, Ga. Dept. of Physics.
SOME METHODS IN HIGH ENERGY COSMIC RAY MEASUREMENT
Julian B. Shand, Jr. *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 10 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 03B

99 GENERAL

N81-11977*# Alabama Univ. in Huntsville.
RESEARCH REPORTS: THE 1980 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM Report, 26 May - 1 Aug. 1980
B. F. Barfield, ed., Marion I. Kent, ed. (NASA. Marshall Space Flight Center), James Dozier, ed. (NASA. Marshall Space Flight Center), and Gerald Karr, ed. Oct. 1980 722 p refs Fellowship program held at NASA. Marshall Space Flight Center, 26 May - 1 Aug. 1980 Prepared in cooperation with Alabama Univ., University
(Grant NGT-01-022-099)
(NASA-CR-161511) Avail: NTIS HC A99/MF A01 CSCL 05A

The Summer Faculty Fellowship Research Program objectives are: to further the professional knowledge of qualified engineering and science faculty members; to stimulate an exchange of ideas between participants and NASA; to enrich and refresh the research and teaching activities of participants and institutions; and to contribute to the research objectives at the NASA centers. The Faculty Fellows engaged in research projects commensurate with their interests and background and worked in collaboration with a NASA/MSFC colleague. For individual titles, see N81-11978 through N81-12009.

N81-11978*# Colorado Univ., Boulder.
DEVELOPMENT OF A FACILITY FOR LARGE-SCALE TESTING OF MULTISTORY BUILDINGS **c09**
Daniel P. Abrams *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 16 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 14B

Current experimental research pertaining to response of structures subjected to lateral loads such as strong winds or earthquake motions is limited to either tests of single structural components or small scale multistory structures. The feasibility of developing a facility where large scale multistory structures could be loaded to failure is discussed. The test facility would consist of a series of hydraulic actuators mounted on reaction frames currently in use at the Marshall Space Flight Center for structural testing of spacecraft components. The actuators would be controlled from signals computed by an on-line analysis of measured data. This method of loading could be used to simulate inertial forces resisted by a structure behaving in the non linear range of response subjected to motion at the base or to impulses along the height as would occur during a strong earthquake or wind. Author

N81-11979*# Alabama Univ. in Huntsville.
MSFC PERSONNEL MANAGEMENT TASKS: RECRUITMENT AND ORIENTATION OF NEW EMPLOYEES **c81**
Thomas A. Brindley *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 20 p (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 05A

In order to encourage highly motivated young students to learn about NASA and consider it for a career, a formal program is to be initiated whereby selected students can work on a voluntary basis at Marshall Space Flight Center (MSFC). The first task was to develop the working plan and procedures for this program, called Student Volunteer Service Program, in the writing of MSFC official guidelines, the Marshall Management Instruction (the MMI) which is a binding document that defines policy and establishes procedures and guidelines. Particular considerations written into the MMI after numerous consultations, interviews, and discussions about a satisfactory policy, include: arrangements to be made between the student, the school authorities, and concerned MSFC employees; management of the work assignments; and procedures for the student's welfare and safety. The second task was the development of a recruitment brochure for the attraction of new employees, especially scientists and engineers. The third task assigned was to develop a plan called Orientation of New Employees. E.D.K.

N81-11980*# Alabama Univ., Tuscaloosa.
ANALYSIS AND IMPROVEMENT OF CONTACT DYNAMICS SIMULATION USING THE SIX DEGREE OF FREEDOM MOTION SYSTEM **c13**
Richard C. Brown *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 50 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 22A

The 6 DOF motion system was employed for closed loop simulation of the contact dynamics involved in the docking of two satellites. Under most initial conditions the system gives inaccurate results. It is well known that the presence of a time lag can generate instability in closed loop systems. In order to see if the time lag (about 200 ms.) in the 6 DOF system can can satisfactorily account for its errors, a simple computer model of the system incorporating this lag and other revelant parameters was implemented. The model in fact does predict all the observed rebound errors with reasonable precision. Also, since it is probable that the time delay can only be reduced but not eliminated, various compensation schemes were devised. Two give adequate correction for delays under 100 ms for a non preloaded probe. More powerful schemes may be adequate for the present 200 ms. environment and the presence of a preload. E.D.K.

N81-11981*# Alabama Univ. at Huntsville. Dept. of Physics.
PILOT SIGNALS FOR LARGE ACTIVE RETRODIRECTIVE ARRAYS **c32**
C. H. Chan *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 17 p refs (For primary document see N81-11977 02-99)
(Grant NGT-01-002-099)
Avail: NTIS HC A99/MF A01 CSCL 20N

It was suggested that for large active retrodirective arrays, as in the solar power system, a two tone uplink pilot signal with frequencies symmetrically situated around the downlink frequency be used in order to reduce ionospheric biases and to lower the cost. Unfortunately such a system faces the following difficulties: (1) the pi-ambiguity, and (2) a large phase difference between the downlink and uplink signals. It is shown how the pi-ambiguity can be easily removed by using a two tone uplink signal with both frequencies situated at one side of the downlink frequency, and the phase difference can be greatly reduced with a three tone or a four tone uplink pilot signal. E.D.K.

N81-11982*# Alabama Univ. in Huntsville. Dept. of Physics.
ION PLATING STUDIES FOR HIGH TEMPERATURE APPLICATIONS **c26**
Jack H. Davis *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 17 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 11F

An experimental project was undertaken to ion plate, by electron beam evaporation, Al films onto 4340 steel substrates using (and at the time troubleshooting) the custom built V.T.A. 7375 electron beam ion plating system. A careful recent literature and commercial vendor survey indicates possible means of improving the trouble plagued V.T.A. system. Author

N81-11983*# Alabama Univ. in Huntsville. Dept. of Mathematics.
STATISTICAL WIND PROFILE GUST MODEL **c47**
Deva C. Doss *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 9 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 04B

A statistical wind profile gust model for the Space Transportation Operations and Trade Studies is developed by using 1800 Jimsphere wind profile data collected at Cape Kennedy during 1965 to 1972. Wind profiles from the surface to 20 km in component form, i.e., zonal and meridional are processed through the digital filters of different wave length ranges bases on the Martin-Graham cosine rolloff model. The residuals obtained from the filtering processes for the data base for the statistical analysis. For each wind component the gust and gust length at a specified reference altitude in a residual profile are defined. A two parameter gamma probability marginal distribution seems to fit the component gust amplitude and the gust length when

redefined. The problem of finding an appropriate bivariate joint distribution of the gust amplitude and length remains to be solved. The probability distribution of the modulus of the gust amplitudes was derived under the assumption that they are independently distributed as gamma variates. E.D.K.

N81-11984*# Missouri Univ. -Columbia. Dept. of Industrial Engineering.

UPGRADING THE FREE FLYING RENDEZVOUS AND DOCKING SIMULATOR AND THE ORBITAL SERVICER SYSTEM c14

Robert M. Eastman *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 31 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 14B

Recommendations are made for upgrading two teleoperator/robotics test and simulation systems based upon a review of latest technology advances in the involved disciplines. A second generation Free Flying Mobility Unit is recommended which adds a sixth degree of freedom and incorporates other improvements which greatly expand the center's capability to perform evaluation tests and demonstrations of advanced systems concepts for rendezvous and docking in support of the Teleoperator Maneuvering System (TMS) Program. The Orbital Servicer System provides the capability for testing and demonstrating concepts for on orbit servicing of compatibly designed satellites/payloads. The TMS is to be the transporting vehicle for the servicer. The manipulator arm of the Orbital service System is presently computer controlled in the trajectory portion of the module transfer operation. The ultimate objective is to fully automte its operation requiring additional capabilities in sensors, artificial intelligence, image analysis, communications, computer programming, pattern recognition, kinematics, and manipulator design. It is recommended that the Electronics and Control Laboratory move to acquire the basic competencies in robotics necessary to achieve full automation. E.D.K.

N81-11985*# Alabama Univ. in Huntsville. Dept. of Mathematics.

MATERIAL AND PROCESS CONSTRAINTS FOR A FLAT INTERFACE IN THE BRIDGMAN-STOCKBARGER TECHNIQUE c76

Larry M. Foster *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 21 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20L

The functional relationships between various material and process parameters necessary for a flat interface in the Bridgman-Stockbarger technique are given. In particular, two boundary condition cases are considered. The findings imply that the material and process parameters cannot be arbitrary if a flat melt-solid interface is to be achieved. The sensitivity of one parameter to changes in another parameter suggests great care should be taken in obtaining the various material parameters. E.D.K.

N81-11986*# Auburn Univ., Ala. Dept. of Mathematics.

A RANKING ALGORITHM FOR SPACELAB CREW AND EXPERIMENT SCHEDULING c54

Robert D. Grone and Frank H. Mathis *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 18 p (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 05H

The problem of obtaining an optimal or near optimal schedule for scientific experiments to be performed on Spacelab missions is addressed. The current capabilities in this regard are examined and a method of ranking experiments in order of difficulty is developed to support the existing software. Experimental data is obtained from applying this method to the sets of experiments corresponding to Spacelab mission 1, 2, and 3. Finally, suggestions are made concerning desirable modifications and features of second generation software being developed for this problem. M.G.

N81-11987*# Athens Coll., Ala. Dept. of Biology.

CONTINUOUS FLOW ELECTROPHORESIS: THE EFFECT OF SAMPLE CONCENTRATION ON THROUGHPUT AND RESOLUTION IN AN UPWARD FLOWING SYSTEM c25

Thomas S. Jandebeur *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 27 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 07D

The effect of sample concentration on throughput and resolution in a modified continuous particle electrophoresis (CPE) system with flow in an upward direction is investigated. Maximum resolution is achieved at concentrations ranging from 2 x 10 to the 8th power cells/ml to 8 x 10 to the 8th power cells/ml. The widest peak separation is at 2 x 10 to the 8th power cells/ml; however, the sharpest peaks and least overlap between cell populations is at 8 x 10 to the 8th power cells/ml. Apparently as a result of improved electrophoresis cell performance due to coasting the chamber with bovine serum albumin, changing the electrode membranes and rinse, and lowering buffer temperatures, sedimentation effects attending to higher concentrations are diminished. Throughput as measured by recovery of fixed cells is diminished at the concentrations judged most likely to yield satisfactory resolution. The tradeoff appears to be improved recovery/throughput at the expense of resolution. M.G.

N81-11988*# Drake Univ., Des Moines, Iowa. Dept. of Mathematics and Computer Science.

MODELING A MAINTENANCE SIMULATION OF THE GEOSYNCHRONOUS PLATFORM c14

A. F. Kleiner, Jr. *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 28 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 22B

A modeling technique used to conduct a simulation study comparing various maintenance routines for a space platform is dicussed. A system model is described and illustrated, the basic concepts of a simulation pass are detailed, and sections on failures and maintenance are included. The operation of the system across time is best modeled by a discrete event approach with two basic events - failure and maintenance of the system. Each overall simulation run consists of introducing a particular model of the physical system, together with a maintenance policy, demand function, and mission lifetime. The system is then run through many passes, each pass corresponding to one mission and the model is re-initialized before each pass. Statistics are compiled at the end of each pass and after the last pass a report is printed. Items of interest typically include the time to first maintenance, total number of maintenance trips for each pass, average capability of the system, etc. M.G.

N81-11989*# Atlanta Univ., Ga. Dept. of Mathematics.

AXIALLY SYMMETRIC MOTION OF A ROTATING STRATIFIED FLUID c34

Benjamin J. Martin *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 17 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20D

The spherical modeling of geophysical fluid flow is examined. In particular the extension of some previous work done in spherical geometry to the specific case of interest in the Spacelab atmospheric circulation experiment is discussed. This involves changing the boundary conditions under which the basic equations are to be solved. For simplicity the linear, axially symmetric steady state solution is sought. M.G.

N81-11990*# Alabama Univ. in Huntsville. Development Learning Program.

PAYLOAD CREW TRAINING COMPLEX (PCTC) UTILIZATION AND TRAINING PLAN Status Report c53

Michael R. Self *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 20 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 05I

The physical facilities that comprise the payload crew training complex (PCTC) are described including the host simulator; experiment simulators; Spacelab aft flight deck, experiment pallet, and experiment rack mockups; the simulation director's console; payload operations control center; classrooms; and supporting soft- and hardware. The parameters of a training philosophy for payload crew training at the PCTC are established. Finally the development of the training plan is addressed including discussions of preassessement, and evaluation options. M.G.

N81-11991*# Berry Coll., Mount Berry, Ga. Dept. of Physics.
SOME METHODS IN HIGH ENERGY COSMIC RAY MEASUREMENT **c93**
Julian B. Shand, Jr. *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 10 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 03B

Problems concerning ion chamber and emulsion detection techniques for high energy cosmic ray measurement are investigated. The calculation of the average energy actually deposited in an ion chamber by an ultra-high energy particle of large mass and charge is examined. A calculational scheme already applied successfully to particles of charge 1 is extended. Also, the calibration of a plate of plastic scintillator for measurement of the position of a cosmic ray shower passing through it is discussed. The method of calibration is to inject pulses of flight at known positions on the plate and record the responses of photomultiplier tubes at the corner of the plate. M.G.

N81-11992*# Colgate Univ., Hamilton, N.Y. Dept. of Chemistry.
PHOTOCHEMISTRY OF MONODENTATE AND BIDENTATE CARBONATO COMPLEXES OF RHODIUM (3) **c25**
Peter S. Sheridan *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 22 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 07D

A scheme for the photochemical fixation of water is proposed which involves a five-step reaction sequence; the first step involves the 2 electron reduction of a metal by a coordinated carbonate ligand, with corresponding oxidation of the carbonate to CO2 and O2. Ligand field photolysis of trans- (RH(en)2 H2O CO3) ClO4, and (Rh(en)2 CO3) CLO4 have been studied in the solid state and in aqueous solution at various pH values. Both salts are photoinert in the solid phase, but are quite photoreactive in aqueous solution. In solution, the monodentate ion undergoes efficient isomerization to a mixture of cis and trans - (Rh(en)2 H2O CO3)+, presumably with water exchange. A minor pH increase upon photolysis is evidence of inefficient carbonate (CO3 =) release, with formation of (Rh(en)2 (H2O)2)3+. In contrast, aqueous solutions of the bidentate carbonato complex undergo efficient pH decrease upon ligand field photolysis. Changes in the electronic spectrum (200-500 nm) and pH changes indicate that the desired redox is occurring. The pH increase is due to the aqueous behavior of CO2. M.G.

N81-11993*# Fisk Univ., Nashville, Tenn. Dept. of Physics.
CALCULATIONS AND MEASUREMENTS IN SUPPORT OF THE TRIGLYCINE SULFATE ZERO GRAVITY GROWTH EXPERIMENT **c12**
John M. Springer *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 19 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 07D

Two areas of investigation which are required for maximum utilization of the flight experiment results from the solution growth of crystals of triglycine sulfate (TGS) are addressed. The use of an ultramicroscope to characterize structural defects in the grown TGS crystals is discussed. Mie theory is applied to the light scattering expected from idealized crystal defects in order to predict the sensitivity of ultramicroscopy in the detection of small defects. Secondly, the measurement of optical properties of TGS solutions in water is discussed. This data is needed in order to interpret interferometric studies of mass transport through the TGS solution during the growth phase of the flight experiment. In particular, refractive index data is obtained for a wide range of temperatures and concentrations of TGS solutions. Absorbance measurements in the ultraviolet have also been made for the same samples. M.G.

N81-11994*# Military Academy, West Point, N. Y. Dept. of Mechanics.
FLUID DYNAMIC ANALYSIS OF THE SPACE SHUTTLE MAIN ENGINE HIGH PRESSURE OXIDIZER TURBOPUMP SLINGER SEAL **c37**
James S. Voss *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 22 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 11A

The details of the flow on the bladed side of a centrifugal type dynamic shaft seal utilized to contain liquid oxygen in the Space Shuttle Main Engine high pressure oxidizer turbopump were clarified. The governing equations are solved to predict the pressure and temperature gradients and to aid in investigating the nature of the liquid-vapor interface. Recommendations for design improvements are discussed. Author

N81-11995*# Alabama Univ. in Huntsville. Dept. of Mechanical Engineering.
VALIDATION OF THE SOLAR HEATING AND COOLING HIGH SPEED PERFORMANCE (HISPER) COMPUTER CODE **c44**
Donald B. Wallace *In its* Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 23 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 10A

Developed to give a quick and accurate predictions HISPER, a simplification of the TRNSYS program, achieves its computational speed by not simulating detailed system operations or performing detailed load computations. In order to validate the HISPER computer for air systems the simulation was compared to the actual performance of an operational test site. Solar insolation, ambient temperature, water usage rate, and water main temperatures from the data tapes for an office building in Huntsville, Alabama were used as input. The HISPER program was found to predict the heating loads and solar fraction of the loads with errors of less than ten percent. Good correlation was found on both a seasonal basis and a monthly basis. Several parameters (such as infiltration rate and the outside ambient temperature above which heating is not required) were found to require careful selection for accurate simulation. A.R.H.

N81-11996*# Wisconsin Univ., Platteville.
INCIPIENT FAILURE DETECTION (IFD) OF ANTIFRICTION BALL BEARINGS **c37**
David Y. Wang *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 24 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 13I

Two methods were investigated for retrieving the ball bearing signals buried by the overall signature of an operating large engine such as the main space shuttle engine. The signal averaging method averages n^{**} signals over a time duration equaling the known period of the ball bearing defect frequency. With this method, the desired ball bearing defect signal will be enhanced over the noise by a factor of the square root of n. A second method is to perform a further frequency analysis on the logarithmic spectrum in order to detect and separate different families of harmonics and sidebands, thereby giving information about modulating frequencies. These two alternate IFD methods were carried out with a Norland 3001 waveform and data system. The obtained results are then compared with the power spectral density (PSD) of the overall machine signals and conclusions are made accordingly. A.R.H.

N81-11997*# Athens Coll., Ala.
PULSED EDDY CURRENT TESTING **c33**
Gary L. Workman *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 18 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 09C

Since a large number of the procedures used for inspecting the external tank are concerned with determining flaws in welds, there is a need to develop an inspection technique, which can be automated, to determine flaws in welds and structures with complex geometries. Techniques whereby an eddy current is generated in a metallic material and the changes in the circuit parameters due to material differences are observed, were chosen as one possible approach. Pulsed eddy current and its relationship to multifrequency techniques is discussed as well as some preliminary results obtained from observing pulsed waveforms with apparatus and algorithms currently in use for ultrasonic testing of welds. It can be shown the pulsed eddy current techniques can provide similar results, can eliminate some of the noncritical parameters affecting the eddy current signals, and

can facilitate in the detection of critical parameter such as flaws, subsurface voids, and corrosion. A.R.H.

N81-11998*# Tennessee Univ. Space Inst., Tullahoma.
STABILITY OF THE STRATIFIELD CYLINDRICAL ANNULUS FLOW **c34**
Basil N. Antar *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 13 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20D

The linear stability analysis for the stratified flow between two rotating circular cylinders is formulated. Two approaches for the stability analysis are presented. The first approach results in an algebraic eigenvalue problem, while the second results in an initial value problem for the perturbation function. The advantages and disadvantages of both approaches are discussed and a preferable numerical solution technique is outlined. Author

N81-11999*# Berry Coll., Mount Berry, Ga.
ON ROSEN'S THEORY OF GRAVITY AND COSMOLOGY **c46**
Ronnie C. Barnes *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 13 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 08F

Formal similarities between general relativity and Rosen's bimetric theory of gravity were used to analyze various bimetric cosmologies. The following results were found: (1) physically plausible model universes which have a flat static background metric, have a Robertson-Walker fundamental metric, and which allow co-moving coordinates do not exist in bimetric cosmology. (2) it is difficult to use the Robertson-Walker metric for both the background metric (gamma mu nu) and the fundamental metric tensor of Riemannian geometry(g mu nu) and require that g mu nu and gamma mu nu have different time dependences. (3) A consistency relation for using co-moving coordinates in bimetric cosmology was derived. (4) Certain spatially flat bimetric cosmologies of Babala were tested for the presence of particle horizons. (5) An analytic solution for Rosen's k = +1 model was found. (6) Rosen's singularity free k = +1 model arises from what appears to be an arbitary choice for the time dependent part of gamma mu nu. A.R.H.

N81-12000*# Arkansas Univ. at Little Rock.
MEASUREMENTS OF THE SAMPLING VOLUME OF AN INFRARED LASER DOPPLER VELOCIMETER FOR THE STUDY OF FEASIBILITY OF SIMULTANEOUS THREE-DIMENSIONAL VELOCITY PROFILE MAPPING **c36**
Robert L. Bond *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 26 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20E

High resolution incoherent mapping of the sampling volume was performed to determine the three dimensional profile of the volume of the beam from which information can be obtained by scattering. The incoherent sampling volume of the infrared laser Doppler velocimeter was found to be heavily dependent upon the configuration of the outgoing laser beam. In general when only half the beam is allowed to focus at the focal plane, the x, y traverses indicate a broader beam with nominal side lobes. However, if the total beam is permitted to impinge on the focal plane there is substantial narrowing of the beam with increased maximum intensity and an increase in side lobes. The double maximum indicated by the coherent sampling volume appears to be an artifact of the scanning process not a fundamental entity of the sampling volume. A.R.H.

N81-12001*# Columbus Coll., Ga.
A MONTE CARLO APPROACH TO TOLERANCE ANALYSIS OF A NEAR-DIFFRACTION LIMITED OPTICAL IMAGING SYSTEM **c74**
W. Harold Davenport *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 16 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20F

A computer program was developed to generate random numbers on the Sigma V computer. A subroutine gave a random real number from a uniform distribution on the interval (0,1). A normal distribution with mean zero and variance 1 was also obtained. R.C.T.

N81-12002*# Alabama A & M Univ., Normal.
POWER DISTRIBUTION FOR ELECTRON BEAM WELDING **c37**
Eugene Edwards *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 31 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 13H

The power distribution of an electron seam is analyzed. Digital computer techniques are used to evaluate the radial distribution of power detected by a wire probe circulating through the beam. Results are reported. R.C.T.

N81-12003*# Florida State Univ., Tallahassee.
MEASUREMENT OF VELOCITY FIELDS IN FLUID DYNAMICS EXPERIMENTS **c34**
Daniel E. Fitzjarrald *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 6 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20D

A microcomputer-video system was used to measure both spatial and temporal variations of two dimensional fluid flow velocity fields. The system utilizes two methods: the first method is the traditional one in which tracers are introduced into the fluid and their position compared at two closely spaced times; and the second method involves scattering coherent light in the fluid and obtaining motion by analyzing the multiple exposed speckle pattern recorded on photographic film. R.C.T.

N81-12004*# Alabama Univ., Tuscaloosa.
ON THE CONTROL AND STABILITY OF THE PINHOLE OCCULTER FLEXIBLE BOOM FACILITY **c14**
Michael Greene *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 31 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 14B

The dynamics and control of the Shuttle based, gimbal mounted, boom pointing system for use in the X-ray pinhole experiments were studied. The overall system stability was studied, and root locus compensation was designed to achieve stability and pointing stability requirements. This single axis control study found the compensated system to be stable and capable of pointing to within 6.5 arc sec while the Shuttle rocks in its 0.1 deg deadband. The system follows step (positon) inputs with zero error and rupm (velocity) inputs with a steady state error coefficient of 4.5/sec. R.C.T.

N81-12005*# Mississippi Univ., University.
FFT METHODS IN SIGNAL PROCESSING OF THE COAL INTERFACE DETECTOR RADAR **c32**
Darko Kajfez *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 18 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 17I

The FM radar for the coal interface detector, operating in the frequency band 2 to 4 GHz, is intended for the display of thicknesses between 2 cm and 20 cm. Because of such a short range, the thickness information is contained in the very few lowest spectral components of the output signal. To overcome this inconvenience, the Fourier series of the output signal was augmented to approximate a Fourier integral. This modification in the signal processing resulted in a higher spectral density, which in turn enabled an easier identification of the interface position in the laboratory. The orientation and spacing of the receiving and transmitting antennas is found to have an important influence on the system performance. R.C.T.

N81-12006*# Alabama Univ. in Birmingham.
EXCHANGE OF STABILITY FOR A COLUMN OF FLUID WITH VARIABLE RAYLEIGH NUMBER UNDER FREE BOUNDARY CONDITIONS **c34**
Letitia Korbly *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 17 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20D

The exchange of stabilities is demonstrated for a system

with harmonic boundary conditions. The motion of fluid in the presence of temperatures gradients is described. It is shown that this principle holds under free, but not rigid or semirigid, boundary conditions. R.C.T.

N81-12007*# South Carolina Univ., Columbia.
IMPROVEMENTS TO THE NASAP CODE **c39**
David Perel *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 76 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 20K

The FORTRAN code, NASAP was modified and improved for the capability of transforming the CAD-generated NASTRAN input data for DESAP II and/or DESAP I. The latter programs were developed for structural optimization. R.C.T.

N81-12008*# Wisconsin Univ., Platteville.
DEPLOYABLE STRUCTURE DESIGN FOR THE SCIENCE AND APPLICATIONS SPACE PLATFORM **c14**
Henry W. Stoll *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 30 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 22B

Basic concepts regarding deployable structures design, including systematic design/classification schemes and a deployability criterion, were proposed for use in synthesis, analysis and evaluation of alternative deployable structure designs. Using design guidelines based on SASP requirements and the basic concepts developed, a variety of designs were synthesized, and these along with previously proposed designs were analyzed and evaluated. Recommendations and conclusions regarding optimal deployable structure design were made. R.C.T.

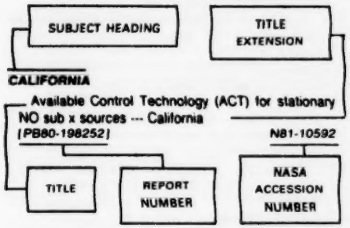
N81-12009*# Jackson State Univ., Miss.
PAYLOAD MAINTENANCE COST MODEL FOR THE SPACE TELESCOPE **c09**
William L. White *In* Alabama Univ. Res. Rept.: The 1980 NASA/ASEE Summer Fac. Fellowship Program Oct. 1980 15 p refs (For primary document see N81-11977 02-99)
Avail: NTIS HC A99/MF A01 CSCL 03A

An optimum maintenance cost model for the space telescope for a fifteen year mission cycle was developed. Various documents and subsequent updates of failure rates and configurations were made. The reliability of the space telescope for one year, two and one half years, and five years were determined using the failure rates and configurations. The failure rates and configurations were also used in the maintenance simulation computer model which simulate the failure patterns for the fifteen year mission life of the space telescope. Cost algorithms associated with the maintenance options as indicated by the failure patterns were developed and integrated into the model. R.C.T.

N81-12010# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
AIR FORCE TECHNICAL OBJECTIVE DOCUMENT FY 1981
Sidney O. Davis Dec. 1979 30 p Supersedes AFML-TR-78-195
(AD-A089709; AFML-TR-79-4222; AFML-TR-78-195) Avail: NTIS HC A03/MF A01 CSCL 15/3

This technical objective document was prepared by the Materials Laboratory and describes the materials technology areas for meeting future Air Force operational needs. The six technology areas encompass the full spectrum of materials capabilities required for future aircraft, missile, space, and electronic systems: thermal protection materials; aerospace structural materials; aerospace propulsion materials, fluid, lubricant, and elastomeric materials; protective coatings and materials, and electromagnetic windows and electronics. Presented for each TA is the general objective, specific goals, technical approaches, and a Laboratory TA focal point who can facilitate face-to-face discussions with Laboratory engineers and scientists. GRA

Typical Subject Index Listing



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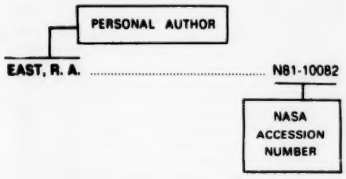

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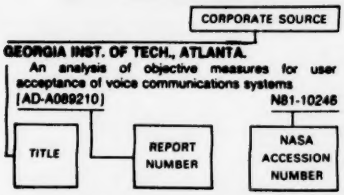

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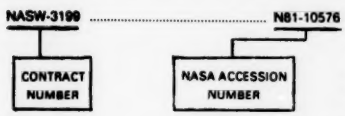

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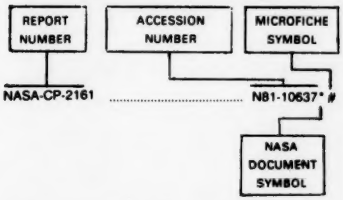

Listings in this index are arranged alpha-numerically by report number. The NASA accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

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